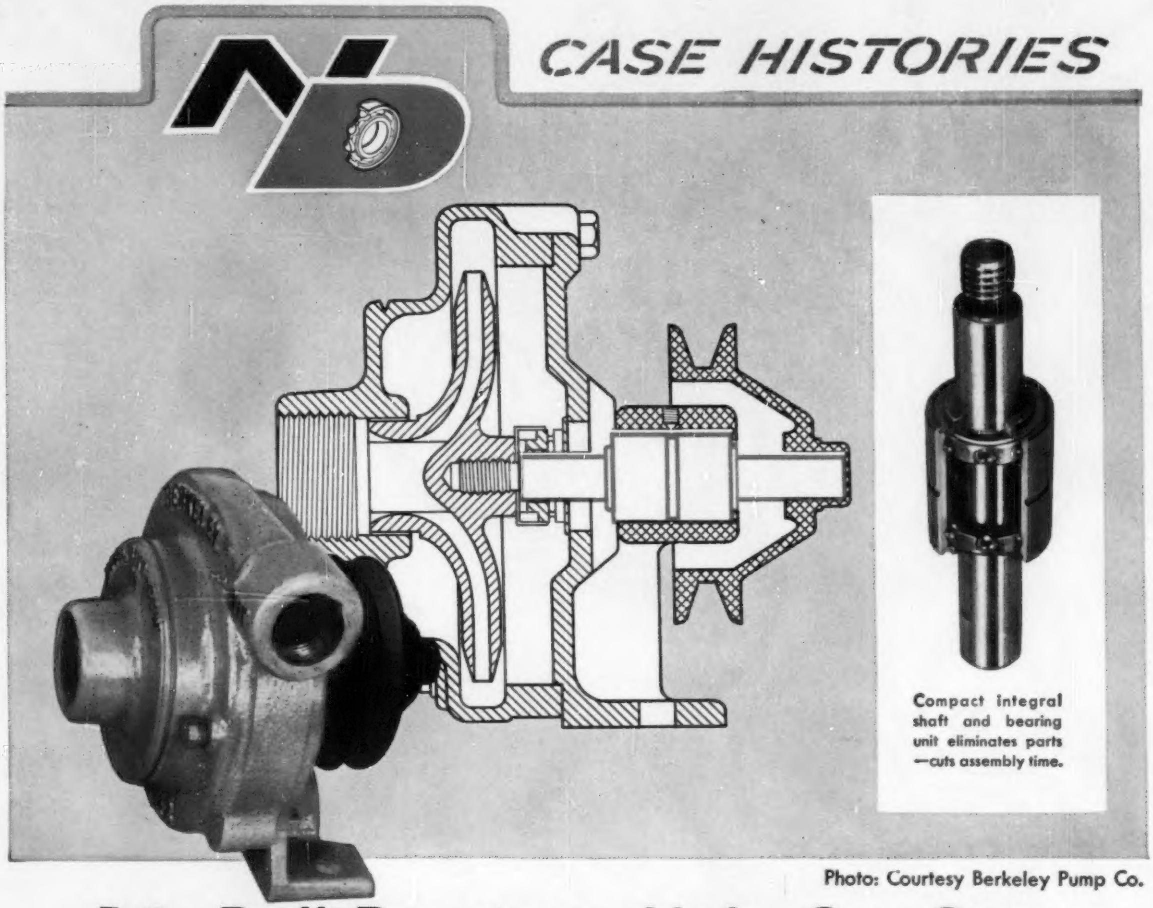
DECEMBER 1958

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers



Compact integral shaft and bearing unit eliminates parts —cuts assembly time.

Photo: Courtesy Berkeley Pump Co.

N/D Ball Bearings Help Cut Size... Lower Costs $2.50 Per Pump!

CUSTOMER PROBLEM:

Redesign utility water pump for Air Conditioner market. Conversion must achieve smaller size without reducing pump capacity. At the same time, customer must lower over-all production costs.

SOLUTION:

N/D Sales Engineer suggested the versatile New Departure fan and pumpshaft ball bearing. This compact precision bearing permitted use of over-the-housing pulleys with belt load located over the raceway. Its integral shaft, which is the inner race, simplified design and helped reduce housing size without changing pump capacity. In addition, the sealed and lubricated-for-life bearing replaced two sealed bearings, separate shaft and snap rings . . . cutting part and assembly-time costs $2.50 per pump.

Perhaps one of New Departure's wide selection of *production* ball bearings will help give *your* product the sales appeal and cost savings you're looking for. For more information, call the New Departure Sales Engineer in your area or write Dept. E-12.

Available through United Motors System and its independent Bearing Distributors.

NEW DEPARTURE

DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NOTHING ROLLS LIKE A BALL

(For more facts circle No. 73 on reply card)

Agricultural Engineering

Established 1920

CONTENTS • DECEMBER, 1958 • Vol. 39, No. 12

INDEX TO VOLUME 39

The title page and index to Volume 39 of AGRICULTURAL ENGINEERING will be mailed with copies of the January 1959 issue to ASAE members and other regular subscribers.

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JAMES BASSELMAN, *Editor and Publisher*

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AE Scholarships Announced

ONE important means of promoting enrollment in agricultural engineering is through scholarships. Since increased enrollment is a natural antecedent to increased membership in ASAE, some good news concerning scholarships has been received during the past few months.

R. J. Alpers, sales engineer, Michigan Vitrified Tile Co., Corunna, Mich., has announced that his company is offering a $300 scholarship to high school graduates, beginning in the fall of 1959. Payment of the scholarship is contingent upon the student's enrollment in the agricultural engineering curriculum at Michigan State University and satisfactory completion of the first term's work. Each applicant will be required to submit a 500-word paper on the subject of "The Application of Agricultural Engineering to our Farm."

Since complimentary copies of AGRICULTURAL ENGINEERING were sent through the courtesy of the Michigan Vitrified Tile Co. to all vocational agricultural schools in Michigan during 1958, it is required that ideas used in the paper be gleaned from reading AGRICULTURAL ENGINEERING and that dates of issues be stated.

James L. Child, Jr., sales engineer, Hancock Brick and Tile Co., Findlay, Ohio, has announced that his company has made available a $300 agricultural engineering scholarship at Ohio State University.

R. D. Barden, chairman of agricultural engineering department, Ohio State University, reports that a $300 agricultural engineering scholarship is available at Ohio State by the Standard Oil Company.

It has been reported also that alumni of Ohio State University have been contributing to a development fund for an agricultural engineering scholarship in tribute to the McCuens. Professor G. W. McCuen is past-president and life fellow of ASAE and former department head at Ohio State.

J. W. Martin, head of agricultural engineering, University of Idaho, also has announced availability of five scholarships to promote enrollment in agricultural engineering.

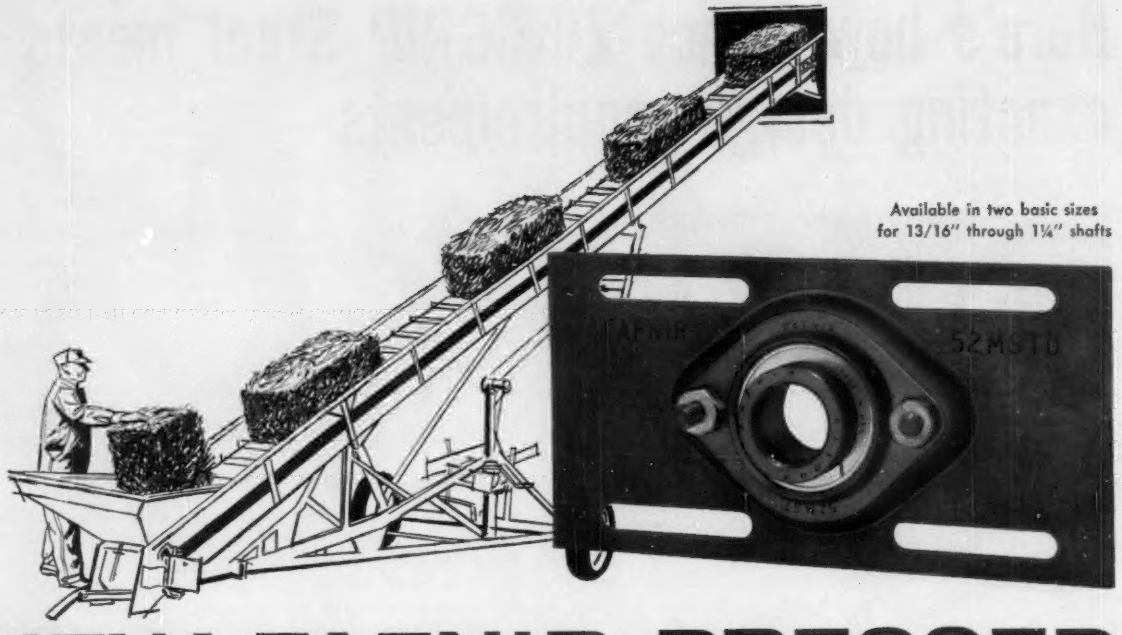
Two $125 scholarships are available to students majoring in agricultural engineering by the Idaho Power Co., and are available to students who come from the company's general service area.

Utah Power and Light Co. offers a $125 scholarship to University of Idaho students majoring in agricultural engineering. The student receiving this scholarship must be from the general territory served by Utah Power and Light Co.

Washington Water Power Co. provides two $125 scholarships each year for University of Idaho students majoring in agricultural engineering. The students must also come from the general service area of Washington Water Power Co.

The University of California has announced availability of the Harry B. Walker Agricultural Engineering Scholarship to graduate students who are citizens of the United States and who declare interest in academic and research activities. The $500 annual award has been made possible by the late Professor Walker (past-president and honorary member of ASAE) and augmented by funds donated by his friends and former students.

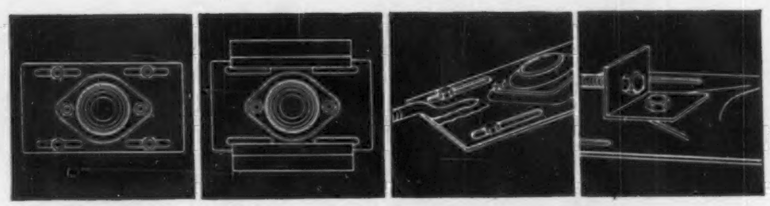
(For more facts circle No. 58 on reply card)



Available in two basic sizes for 13/16" through 1¼" shafts

NEW FAFNIR PRESSED STEEL TAKE-UP UNIT

OFFERS LOW-COST WAY TO MEET LIGHT DUTY REQUIREMENTS



Adaptable to bolt-type or guide-type mounting

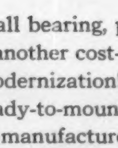
TU bolt may be welded or bolted to unit

With the introduction of the new, ball bearing, pressed steel take-up unit, Fafnir chalks up another cost-cutting contribution to farm implement modernization!

This light-but-rugged, compact, ready-to-mount "package" offers down-the-line savings to manufacturers who have been making their own take-ups for light-duty installations. It can also be used in place of heavier, more costly types where excessive weight and capacity are not needed. Available in two basic sizes covering eight different shaft dimensions, the new unit is adaptable to either guide-type or bolt-type methods of mounting and can accommodate misalignment without adjustment.

The sealed and permanently prelubricated Fafnir ball bearing needs no in-service attention. It has "built-in" self-alignment to compensate for differences in take-up on either side of a shaft. The bearing is equipped with the Fafnir-originated self-locking collar, incorporating the eccentric cam principle that simplifies installation to a twist of the wrist. No machining of shaft shoulders is needed...no mounting devices.

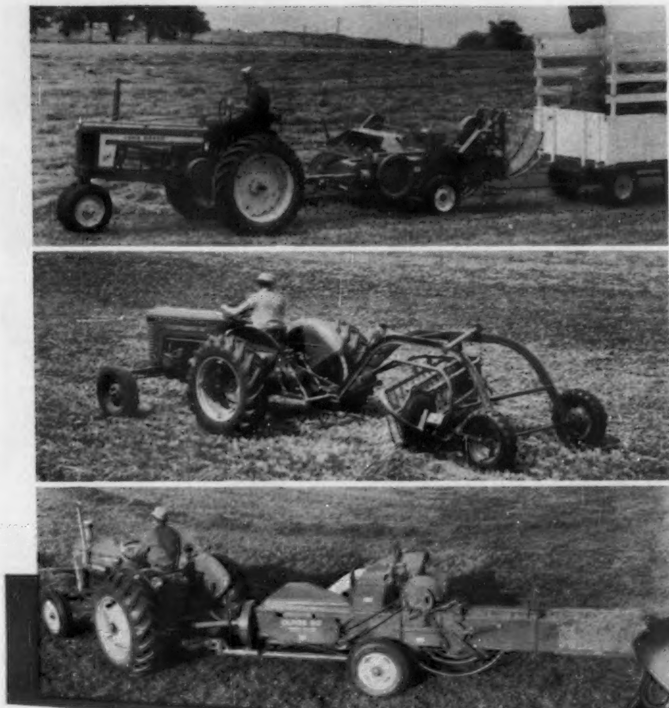
For complete information on how the new, cost-cutting Fafnir take-up unit can be adapted to your requirements, contact your Fafnir representative. Or write The Fafnir Bearing Company, New Britain, Conn.



Fafnir Extended Inner Ring Ball Bearing with Plya-Seals and Self-Locking Collar

FAFNIR BALL BEARINGS
Most Complete Line in America

(For more facts circle No. 68 on reply card)



Names you can depend on *themselves* depend on BLOOD BROTHERS Universal Joints

Names like these recall a great, pioneering history of building new and better implements. Now they stand for integrity and dependability. They are names *you can rely on* for quality farm equipment.

In turn, these famous names rely on Blood Brothers Universal Joints, built by Rockwell-Standard to "get the power through" dependably.

Our own engineers work as a team with implement designers, furnishing invaluable experience in working out drive-line problems. When *you* have a problem, write or call. Our engineers will gladly cooperate.

For general information, request Bulletin 557.

ROCKWELL-STANDARD CORPORATION

Blood Brothers Universal Joints

ALLEGAN, MICHIGAN

UNIVERSAL JOINTS
AND DRIVE LINE
ASSEMBLIES

(For more facts circle No. 54 on reply card)

Meeting the Challenge of Conservation

Conservation *is* a challenge. Today, it is much more than an individual problem . . . it is a challenge to an entire nation — farmers, conservationists, businessmen, manufacturers alike.

An aroused nation is tallying up the costs of last May's disastrous floods in terms of wasted lives, lands and fortunes. The water that falls on the uplands is now recognized as much a national problem as a contagious disease. Community and nationwide action is called for. This year's killer floods have amply demonstrated that the soil and water conservation jobs an individual farmer with limited-duty tractors can practice — such as contour farming and strip cropping — are inadequate to control violent downpours.

While the potential flood is still a trickle, the farmer needs strong terraces, dams, diversion channels. Caterpillar equipment — tractors, scrapers, bulldozers and motor graders — are the tools that can stop the floods before they start. These are the machines that will implement the watershed program — will hold the rain in check — will keep the soil home on the farm.

CATERPILLAR TRACTOR Co., Peoria, Illinois, U.S.A.

Here's an example of how one conservation contractor and his CAT equipment answer the challenge:

Kanipe Bros., Sturgis, Kentucky, own this Cat D7 Tractor shown here, and several other Caterpillar Diesel Tractors. Kanipe Bros. are conservation contractors, specializing in farm improvement work. Over the years they have built many miles of terraces and grassed waterways, straightened creeks, cleared countless acres of land, worked on watershed projects, etc. Dorris Kanipe, partner, says, "It's easy to get more work when you own Cat Diesel Tractors!" His D7 is shown filling in a gully that cuts a large field into two irregular fields.

FREE BOOKLET — "Stop your floods before they start . . ." Write Dept. AE128, Caterpillar Tractor Co., Peoria, Ill.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

CONSERVATION PARTNERS:
CATERPILLAR DEALERS
CONSERVATION CONTRACTORS

(For more facts circle No. 59 on reply card)

Report to Readers . . .

AUTOMATIC UNLOADER COMPLETELY EMPTIES FLAT-BOTTOM GRAIN BIN

The unloading disadvantage of a flat-bottom storage bin, compared with a hopper-bottom bin, is now virtually wiped out by a simple, automatic bin unloader designed by a USDA agricultural engineer at the Illinois AES. This unloader consists of two augers. In addition to the usual auger unloader, a sweep auger gathers the contents from the floor and sides of the bin and delivers it to a small hopper in the center. From this center hopper the discharge auger moves the material into another conveyor. The sweep auger is pivoted at the center of the hopper in the center of the bin, and the closer it operates to the floor, without touching it, the more completely will it clean the bin. . . . . Also, the torque in the vertical drive shaft of the sweep auger propels it over the floor. A drag brake was added to this auger to increase the torque in the vertical shaft. Regulation of the brake loads the auger properly to handle various materials, thereby protecting the motor from overloading. . . . . The rate of discharge is controlled by auger sizes, operating speeds, and size of motor used.

RUSSIAN ENGINEER HAS SIMPLE METHOD FOR MEASURING COMPACTION OF SOIL

One of our British contemporaries, "Farm Mechanization," reports that a Russian engineer has developed a new method by which the precise effect of tractor wheels or tracks on soil may be defined. . . . . By means of a probe, lead pellets are placed in a regular pattern in the soil of a test track. The topmost pellets are on the surface, while the lowest ones are placed at a depth below any possible soil deformation. To one side of the test track, a hole is dug and in it is placed a unit containing radioactive cobalt. Another hole is dug on the other side of the track, and in it is inserted a metal holder having an adapter with an X-ray film. After a tractor is driven across the prepared test track, a pair of gamma photographs is taken to show the new positions of the pellets, which in turn are plotted on a graph, thereby recording the displacement of each pellet both in the horizontal and vertical directions. In this manner, the extent of the compaction or deformation of any given type of soil is measured.

HEX-AND-HEX FASTENERS LIKELY TO OBSOLETE SQUARE NUTS AND BOLTS

A major step in fastener simplification would result from consolidating in one hex bolt and hex nut the best features of four other types of fasteners, according to R,B & W. The advantages to industry of such simplification would be a fastener of improved quality, also a finished product of better appearance and lighter weight. It would enable industry, at no extra cost, to achieve easier and faster assembly plus simplification of specifications and parts to be stocked. . . . . Another thing, since flow lines in steel are distorted less in heading hex bolts, as compared with square-head bolts, strength would be greater and tolerances closer in the case of the former.

MECHANICAL BLUEBERRY PICKER DEVELOPED BY RESEARCH TEAM

Not far from where this journal is published each month comes news of an experimental mechanical blueberry picker that showed up well this past season. Two USDA agricultural engineers and an MSU horticulturist make up the research team that for two years has been experimenting with mechanical harvesting. The harvesting technic they developed for blueberries includes a cloth-covered catching frame that can be moved along the row and under the bushes. A vibrating-type tool is used to shake the branches, and the ripe berries fall into the catching frame. There are vents at the bottom of the frame to funnel the berries into lugs. A number of vibrating tools were tried, ranging from riveting guns to compressed air devices. One of the more successful appeared to be an electric hoe, with the long handle removed. To separate the picked fruit from leaves and other debris, the researchers used a fanning mill. It is expected that before the end of another season a practical mechanical blueberry picker will have reached the prototype stage.

MECHANICAL PRUNING OF CITRUS TREES UPS YIELDS, REDUCES PRUNING COSTS University of California researchers say mature, thrifty lemon trees may be pruned annually with hedging and topping machines, along with some hand pruning, at a saving of 30 to 50 percent in pruning cost and without sacrificing either yield or quality of fruit. In one machine-pruned lemon orchard annual pruning costs, including brush disposal and corrective hand pruning, averaged $45 per acre for machine-pruned trees compared to $86 for hand pruning. In another experiment, it was found that, with proper timing, even severe hedging did not reduce production, and over a 3-year period the hedged trees produced better than unpruned trees. Other advantages from hedging included 20 percent reduction in spray gallonage for pest control and greater facility in the picking operation and in lighting orchard heaters. . . . . Cutting back orange trees 3 feet on four sides in one experiment resulted in loss of the crop the first season, but they are now bearing crops equal to unpruned trees and the fruit is of larger size. . . . . Hedging and topping machines are still largely in the development stage. One experimental trailer-mounted hedging machine uses twelve 14-in-diameter saws driven by a 25-hp air-cooled engine. This machine has the capacity to hedge lemon, orange or grapefruit trees on two sides of each row at a rate of 3/4 to 1 acre per hour.

ENGINEERS EMPHASIZE LOW COST OF PUMP DRAINAGE FOR CROPLAND Many thousands of acres of potentially good, low-lying cropland have not been fully utilized due mainly to the lack of natural, gravity drainage outlets. However, agricultural engineers in federal and state agencies, who give farmers technical assistance on soil and water matters, have in recent years been advocating more extensive use of engine and motor-driven pumps for lifting drainage water to gravity outlets. Often these outlets are several feet higher than the draintile mains. . . . . Based on a five-year study, a University of Minnesota agricultural engineer recently reported that, depending on how it is installed, a motor-driven pump will use annually between 60 cents and $2.00 in electric current per acre drained. While the cost would be higher in years of above-normal rainfall, it would still be low in comparison with other field expenses.

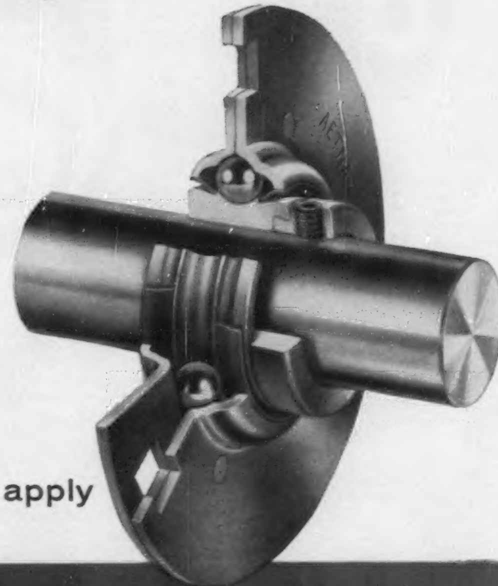
ELECTRONIC REFRIGERATION MOVES INTO THE REALM OF PRACTICALITY Though up to now a laboratory curiosity, electronic refrigeration has moved into the realm of the practical, according to a recent announcement by Westinghouse engineers. Devices for electronic refrigeration are a practical application of the cooling principle first discovered by Peltier in 1834: that is, when an electric current passes in one direction through a junction of two dissimilar metals, cooling is produced in the junction; and if the current is reversed, the junction heats. Such apparatus as compressors, motors, and cooling coils required by conventional cooling technics could be greatly reduced in size and weight in the case of electronic refrigeration.

MAGNET IN THE COW'S STOMACH PREVENTS "HARDWARE DISEASE" Agricultural engineers reporting on experiment station projects concerned with processing of forages have at times referred to efforts to eliminate from such feeds bits of wire and other stray metal, which are the cause of traumatic gastritis or "hardware disease," the yearly toll from which is said to be considerable. These efforts, of course, have all been in the nature of preventive measures. . . . . It is interesting to note, however, that relief from much of the danger from this affliction - though not a cure - has been found. A magnet measuring 1 x 3½ inches and made of nickel-steel alloy to withstand stomach acids, is injected into the cow's reticulum (second stomach) with a balling gun. The magnet attracts any loose hardware and holds it tightly so no sharp ends protrude to irritate or puncture the stomach walls. Magnet and lethal load lie harmlessly on the stomach floor for the life of the cow. The magnet treatment is said to cost about $2.00 per cow.

NOW. . . more manufacturers can afford to put more ball bearing efficiency to work in more places

Aetna

ADAPTER BEARING



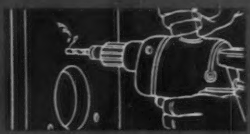
Economical to buy . . . economical to apply

Equipment manufacturers who must stretch bearing dollars in order to build to a price need look no further than this Aetna Adapter bearing —the completely *PACKAGED* ball bearing unit that brings low-cost, anti-friction efficiency within the range of all light-duty slow-speed equipment.

Designed and built-to-be-installed-and-forgotten, this permanently lubricated, sealed-for-life Adapter bearing requires no re-lubrication, no maintenance of any kind. It combines self-aligning bearing, seals, mounting flange and locking collar in a single, compact, factory-assembled *PACKAGE* that mounts easily, quickly, wherever shafts can be supported, including mounting on sheet metal or any semi-rigid structural member. Available in 8 standard shaft sizes, ½" to 1¼". Send for catalog AG-57 or call in the local Aetna representative listed in the yellow pages. Aetna Ball & Roller Bearing Co., Division of Parkersburg-Aetna Corp., 4600 Schubert Ave., Chicago 39, Ill.

EASY, QUICK 3-STEP MOUNTING

1



Drill (or punch) 3 bolt holes in shaft supporting member.

2

Place Adapter bearing in position, insert bolts and tighten nuts.

3

Install shaft, twist locking collar, tighten set screw.

Aetna ANTI-FRICTION CONSULTANT TO LEADING ORIGINAL EQUIPMENT MANUFACTURERS SINCE 1916

(For more facts circle No. 53 on reply card)

CASE self-propelled combine offers

Model "120" combine features power steering, hydraulic travel speed control and Dayton V-Belt drives for more positive threshing, separation and cleaning.

The Case Self-Propelled Model "120" Combine is a revelation in comfort, convenience and driver control as well as in its outstanding capacity to thresh and clean grain and seed crops under a wide range of field conditions.

In design, the "120" has all the latest innovations to save grain, save time and labor and reduce harvesting costs.

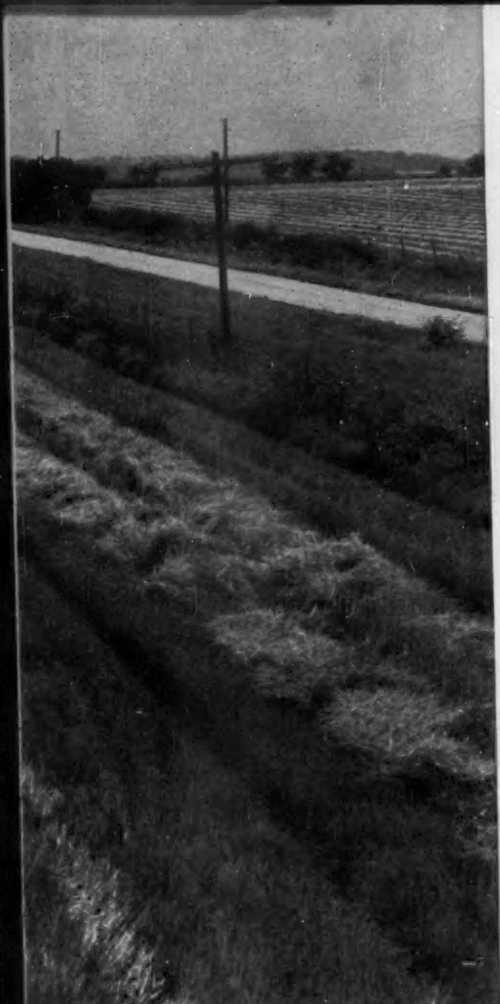
Foremost among the advantages offered is Power Steering, which makes combine operation as simple and pleasant as driving your own car. A big, roomy platform, from which the operator can plainly see header, field, crop and truck or wagon, gives absolute control of harvesting at all times.

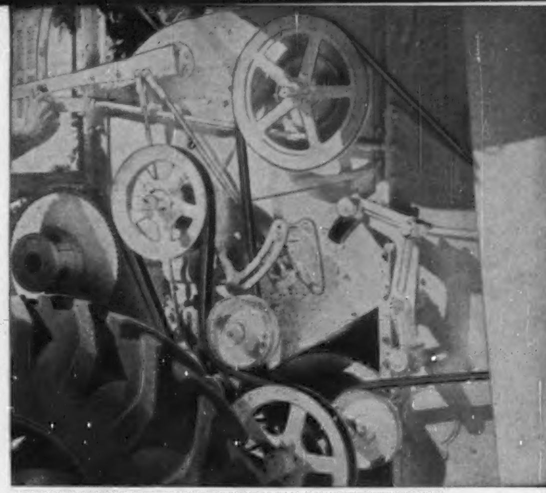
Hydraulic Speed Control, standard equipment on all Case Models "120," provides effortless selection of an infinite number of ground speeds, so speed can be regulated to best suit the particular crop of field condition.

The grain-saving header and feeder provide uniform delivery of grain to the feeder spout and across the full width of the cylinder. Dayton B.S.I.* V-Belts, approved for the cylinder drive — one of the most critical on the combine — provide continuous, uninterrupted rotary power. Specially designed for back side idler operations, Dayton B.S.I. V-Belts dependably transmit all the power from the power source, efficiently, economically.

Possibly a Dayton B.S.I. or one of the complete line of Dayton Agricultural V-Belts is the answer to your power transmission problem. It's worth your while to find out by writing The Dayton Rubber Co., Agricultural O.E.M. Div., Dayton 1, Ohio.

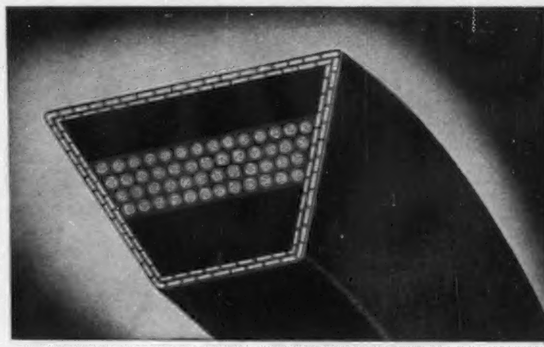
*Back Side Idler



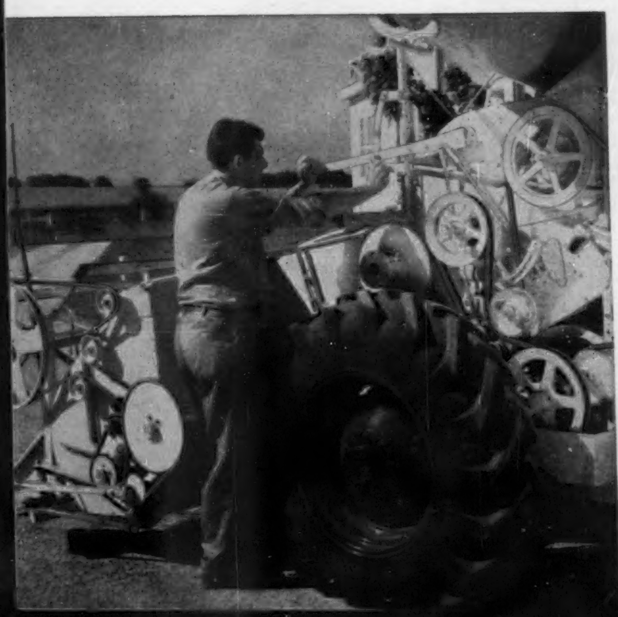


The Case "120" saves hours of time when grain is ready. Equipped with a concave clearance indicator, adjustments for various crops can be made quickly and easily for maximum harvesting efficiency. A variety of special cylinder speeds are available for harvesting beans, grasses, vegetable and flower seeds, flax and other crops.

Specifically built to withstand the stresses of flexing in opposite directions, the Dayton B.S.I. V-Belt is wrap-molded, manufactured of highest quality rubber, cord and fabric.



rs better control, more profitable harvest.



Specially designed to pull on through "slug" loads, Dayton B.S.I.'s have proved their worth on farm equipment for many manufacturers, providing dependable, economical power under all field conditions.

Dayton Rubber

First in Agricultural V-Belts

Agricultural Sales Engineers in Atlanta, Chicago, Cleveland, Dallas, Dayton, Minneapolis, Moline, New York, San Francisco and St. Louis

(For more facts circle No. 51 on reply card)

New International 340 Utility tractor equipped with new 3-point Fast-Hitch. You can get both Farmall and International 240 and 340 tractors with your choice of 2 or 3-point Fast-Hitch, and many other options.

NOW, faster 3-point hitching ...from the seat!

GET YOUR HANDY PERFORMANCE CALCULATOR

Just move the dial on this pocket-size calculator to match tractor speed with implement width—then read off daily plowing, mowing, or harvesting capacity. You get the right answer fast... without figuring! Use this handy calculator to see how much more you can get done in a day with the greater power and *extra* job-matched speeds of new IH tractors. Get this handy calculator from your IH dealer!

Now, IH gives you faster, easier 3-point hitching with automatic latches on all three links. And you do better work than ever with *any* of your 3-point tools!

As with famous IH 2-point Fast-Hitch, you get up-and-down and side-to-side "float." Even wide implements work at uniform depth. Hinged lower draft links assure faster penetration—prevent shallow-out when crossing ridges.

You just set the handy Traction-Control lever to add up to a half ton of weight to tractor drive wheels. New Tel-A-Depth gives you easy, precise implement control.

This new 3-point Fast-Hitch—for Farmall® and International® 240 and 340 tractors—mounts most 3-point tools of other makes. For superior work, select 3-point implements from the *complete* new line of McCormick 3-point equipment. These tools fit practically all 2 and 3-plow, 3-point-hitch tractors.

Try new IH 3-point Fast-Hitch! Hitch or switch implements from the tractor seat. Do better work than ever before—even with your present 3-point tools! Check the *full* line of new McCormick 3-point implements. Just call your IH dealer for a field trial. Set a demonstration date today!

SEE YOUR
INTERNATIONAL HARVESTER DEALER

International Harvester Products *pay for themselves in use*—Farm Tractors and Equipment ... Twine ... Commercial Wheel Tractors ... Motor Trucks ... Construction Equipment—General Office, Chicago 1, Illinois

(For more facts circle No. 56 on reply card)

Agricultural Engineering

December, 1958
Number 12
Volume 39

James Basselman, Editor

A Challenge to American Engineers

Guest Editorial by T. A. Haller

FOR a diversion from strictly engineering subjects, lets look into the field of economics. Engineers are being pulled more and more into top-eschelon management positions so it is well for you to keep a sharp eye on business problems. Actually good engineering and good business are inseparable.

I would like to present a few economic facts, and what I think they mean to us from an engineering viewpoint—and let you draw your own conclusions.

First, let us see what we Americans have accomplished economically over the last 10 years, and where we stand today.

Fig. 1 shows the growth of the gross national product, commonly referred to as GNP and commonly used as an indicator of our prosperity. It is the total of all goods and services produced annually in the United States. *A* shows a growth from 257 to 434 billion dollars, or a 69 percent increase in GNP since 1948. However, nearly half of this increase is just hot air—*inflation!* Line *B* shows GNP corrected to constant 1947 dollars, and now we have figures of 242 billion for 1948 and 335 billion for 1957, or only a 38 percent increase. The difference between lines *A* and *B* is inflation.

Some of our economists propound that this inflation is fine medicine, a good stimulant if administered in regular controlled doses. What good has come from inflation is debatable, but the harm it has done is obvious. It has been wiping out the value of our savings bonds, insurance policies and fixed pensions at the rate of about 2 to 3 percent per year.

When we subtract government expenditures for national security (also on a constant dollar basis), we get line *C* which shows an increase from 227 billion in 1948 to 300 billion in 1957. That is, the production of the goods and services we can use in our daily lives has increased 32 percent in 10 years.

Fig. 2 shows the same indicies as used in Fig. 1, except they are plotted as percent increase over 1948 instead of dollars. Again we see the 69 percent increase for GNP; 38 percent increase of GNP on a constant-dollar basis, and a 32 percent increase when expenditures for national security are subtracted from GNP. Line *D* has been added, which is the same as line *C*, except on a per capita basis. This is the true per capita increase in the goods and services that we can use, and it is only 13 percent. This, I think, is a fair index of how much our standard of living has improved.

Fig. 1 Gross National Product

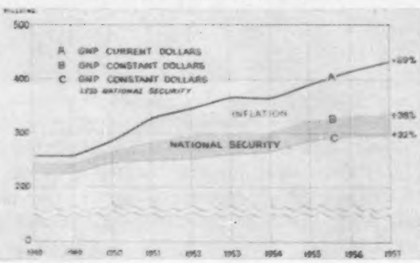


Fig. 2 Percent Increase — Gross National Product

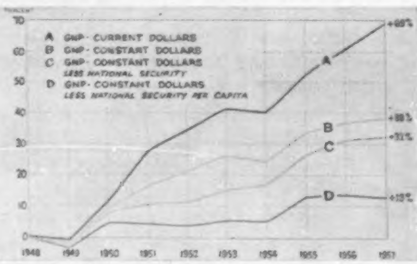
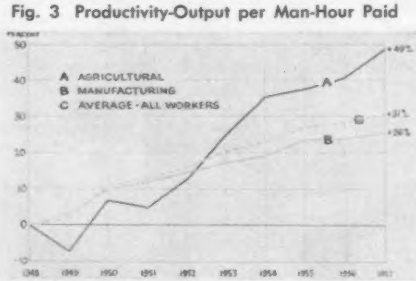


Fig. 3 Productivity-Output per Man-Hour Paid



Note that there has been no significant increase in our standard of living (line *D*) since 1955 even though GNP (line *A*) has been rising rapidly.

The important points are these: (1) Let us not be lulled into complacency by our *apparent* progress as indicated by a 69 percent increase in GNP; actually we are not doing anywhere near that well when all the factors are taken into consideration. (2) A large segment of our people, who are on pensions and who can least afford it, have had their true income reduced about 25 percent because of inflation. The rest of us have prospered so far *in spite of* inflation, but we

(Continued on page 765)

EDITOR'S NOTE: T. A. Haller, vice-president, engineering, J. I. Case Co., presented "A Challenge to American Engineers" during the Michigan Section Meeting held at East Lansing, Mich., October 11, 1958.

Predicting Bearing and Seal Life Expectancy

N. F. Andrews
Member ASAE

Extensive laboratory tests help farm equipment manufacturer select bearings and seals for actual applications

THIS paper reviews results obtained from laboratory testing of bearings and seals by our company during a 12-month period ending December 31, 1957. The report is based strictly on facts that were tabulated when more than 100 bearings and seal assemblies were tested.

Why did our company spend the time and money for extensive laboratory tests of bearings and seals? Briefly, the farmer is demanding longer bearing life in implements that go faster with greater capacity. Our bearing failure complaints were no more than normal but we recognized the need for improved bearing life. Before we could intelligently test an improved bearing design in our field machines, we needed to know more about the reaction of bearing installations that operate in adverse conditions. The best economical approach to the problem forced us to construct laboratory test equipment using a portion of the implement that was most vulnerable to bearing failure. In this case the implement in question was our No. 16 cotton stripper operating in the Texas West Plains area known as the Texas Panhandle.

The most vulnerable parts of the cotton stripper subjected to field conditions are the row units which operate down in the dirt. Other implements such as beet harvesters, potato diggers, and so forth, probably have the same problem. The row units were chosen for our laboratory test program. The pinwheel bearing assemblies mounted on the row unit sides were selected for the tests. Why were the row unit pinwheels selected for tests?

Paper is one of a series of technical lectures on important phases of product design sponsored by the Quad City Section of the American Society of Agricultural Engineers and was presented before the Section at Moline, Ill., January 31, 1958.

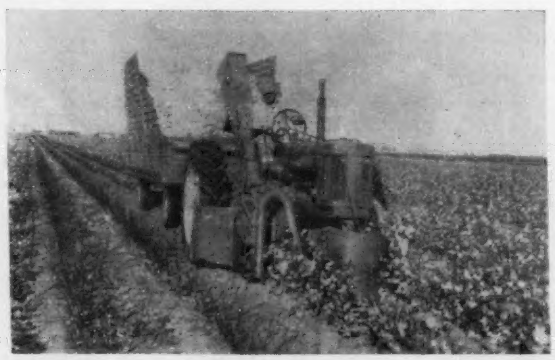
The author — N. F. ANDREWS — is project engineer, cotton harvester, John Deere Des Moines works.

Each row-unit pinwheel assembly is mounted on the housing side. The design facilitates the fast replacement of the unit assemblies. The pinwheels convey the cotton and also agitate the material and sand vigorously. Another reason for selecting the pinwheel assemblies is the extensive use of antifriction bearings on ⅞-in. diameter shafts in the machines that are manufactured at our plant. This whole test program concentrates on the ⅞-in. shaft diameter bearings and seals for the purpose of prolonging the life of the pinwheel installations.

Building a Test Unit

The next step was the fabrication of a suitable test unit that assimilates field conditions as nearly as possible. This test unit consisted of two revised row units converted into sand boxes that were fully enclosed, completely sealed, and able to test 12 unit assemblies at one time. The pinwheels are located inside the boxes with the pins rotating through sand half way up on the pins in the low position. The bearings were not immersed in the sand. The action of the pins through the sand stirred up a dense cloud inside the boxes. Starting each trial test with new sand, enough heat is produced by friction of the pins and sand to discourage anyone attempting to put his hands on the boxes. After intermittently running the test the first 8 hr, the boxes cooled to a 110 F normal temperature for steady 24-hr daily operation. A light load of 0.3 hp at 465 rpm on each unit was obtained by permitting the pins to strike a section of belting suspended from the top.

In testing our present production assemblies we found the real problem was to keep a supply of units on hand for continued testing. What bearings and seals would be tested next? We have managed to keep the tests running continuously without a stop by fabricating various designs from investigations into vendor's bearing and seal suggestions as well as our own. Why does a design engineer select a certain bearing and seal combination for installation in the



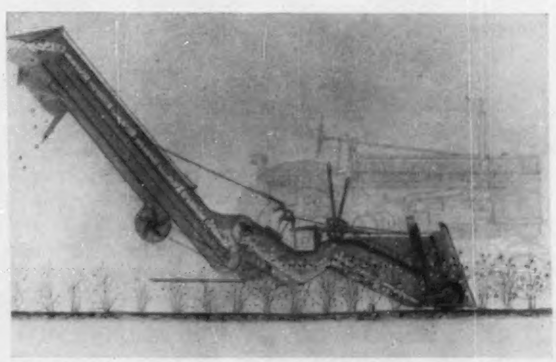


Fig. 1 ***(Above)*** **The row units of a cotton stripper were chosen for laboratory test equipment since dirt is a factor in bearing failure • Fig. 2** ***(Right)*** **Cotton stripper cross section shows pinwheel assembly**

Fig. 3 *(Left)* and Fig. 4 *(Below)* show top and side views of improvised unit for testing pinwheel assemblies

many varied locations on farm implements? Contrary to belief that he copies a previous machine, a competitive machine or sales propaganda, there are some engineers who select a bearing and seal for a specific application based on these three major factors.

Bearing and Seal Selection

First, the bearing must meet the load requirements at a given speed. The engineer has a fair idea of the required load and speed expected in functional operation. A check of calculations with bearing tables easily permits a bearing selection. A practical choice of a bearing from calculated figures that picks a bearing with less than 80 percent of the bearing capacity is a good safe rule of the thumb. In any case this selection can be made from numerical valuation. Alone it would be a lazy, unsafe method.

Second, the bearing design must be economical for the application. With pressure on the engineer to keep the cost down and the quality up for the bearing design, the selection is more difficult than for the first factor. Cost of a designed bearing application can be readily determined, but choice of a bearing that is good enough for a given cost is connected to the third factor.

Third, the bearing life in farm implements is a real factor of ignorance. Granted, the bearing life must be greater than the average life of the implement, but how do you arrive at a safe calculated figure? Even knowing the average life of the machine any calculated value will be highly fictitious. Field operating conditions dictate the life of a bearing, and the many varied conditions result in an indeterminate factor. Each type of implement would have a different value for this factor.

Our No. 16 cotton stripper was no exception. We experienced some bearing failures in the row unit pinwheel assemblies, although the same bearing design had been used many years on other implements. We tried that overworked alibi phrase "unusual conditions". This was not the answer. We had to overcome this factor of ignorance for conditions prevalent in the Texas Panhandle.

The mystery of the "unusual conditions" on investigation became usual conditions in this part of Texas at cotton harvest time. They appeared in the form of fine, extremely abrasive sand blowing and drifting across the fields weekly from the Northwest. After a wind and sandstorm, this sand deposit is picked up by the cotton stripper. A virtual cloud envelopes the bearing installations, thus cutting out the seals and packing the bearings. The sand composition is similar to the volcanic mixture found around Phoenix, Arizona. We shipped four bags of this sand to our plant from Lubbock, Texas. We started testing our regular 1956 pinwheel production assembly in the sand box, to establish a basic result.

A typical bearing assembly (Fig. 5) consisted of 1045C heat treated ⅞-in. diameter commercial shafting, felt seals, straight roller bearings with split outer sleeves. Assembly was greased daily with lithium base grease. The dust cap shown here was not on our 1956 production but came in later for 1957 production. From this initial assembly 38 different bearing and seal combinations ranging from two to 30 samples each have been tested to date.

Analyzing Test Data

I shall not go into all the tests and comparative tests between vendor's name brand products will not be mentioned. Only general classifications of bearings and seals will be reviewed and analyzed from our test data.

Laboratory test results are not a criterion but only a short method to indicate the design that should be tested on future experimental machines in actual field conditions.

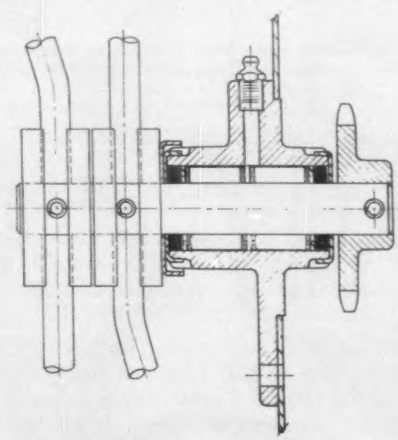


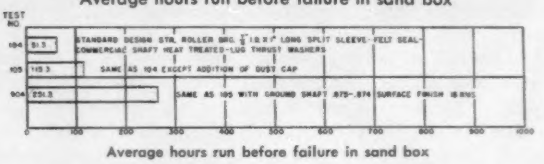
Fig. 5 Typical 1956 production pinwheel assembly

. . . Bearing and Seal Life

In this laboratory test we roughly estimated that the testing of parts was accelerated approximately 2 to 1 over field testing. We did not run the tests very long before we proved the well known fact that bearings and seals are closely related. One is dependent on the other. When the seal cuts out, the bearing fails shortly. The amount of initial running tolerance in the bearing determines the life of the seal. I believe the following graphs will illustrate this point. Even though we were familiar with most of the bearing and seal combinations and performance, some surprising and interesting results were obtained as you will see from the data.

Table 1 is the analysis of mechanical improvements that helped tremendously to extend the bearing life. The first test bar on the chart shows the average time of 51.3 hr that our standard 1956 production pinwheel assembly ran before failure occurred.

TABLE 1 Analysis of mechanical improvements Average hours run before failure in sand box



The second test was the same as the first except for addition of a dust cap. Here the average life was increased to 115.9 hr before failure occurred, or for practical purposes the life of the bearings and seals was doubled.

The third test in this group was the same as the above except the shaft was ground to 0.8745-in. diameter with 16 RMS surface finish. Again the bearing life was doubled or 251.3 hr before failure occurred. In connection with this test several assemblies with ground shafting having surface finishes varying from 70 RMS to 5 RMS were run. There was a noticeable improvement down to 16 RMS but practically no difference between 16 RMS and 5 RMS. This concludes the analysis of the first group of tests. When we state that failure occurred, the bearings are either filled with sand or the wear is so great that the drive chains will not stay on the sprockets. Table 2 shows comparisons of rotary seals. We tested various common seals on 0.875/0.874 ground shafts with 16 RMS finish and with straight roller bearings having split outer races. As you can see the single lip leather seal was the least effective at 233.0-hr average life. The felt seal was just a trifle better at 251.3-hr average life. Next with a decided increase to 352.0-hr average life is the garter spring type of leather seal. Then the triple lip leather seal shows a decided improvement over the garter spring type at 483.3-hr average life. Last improvement in this group of tests is the triple lip neoprene seal at 690.0 hr. Probably the answer to the triple lip neoprene seal over the triple lip leather seal is the increased flexibility of the neoprene rubber over the leather which conforms better to the shaft with the amount of running tolerance originally in the assembly.

TABLE 2 Analysis of rotary seals (⅞-in. I.D. by 1-in. long, straight roller bearings, split sleeve, ground shaft, dust cap)

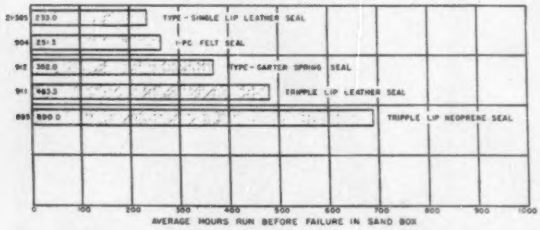
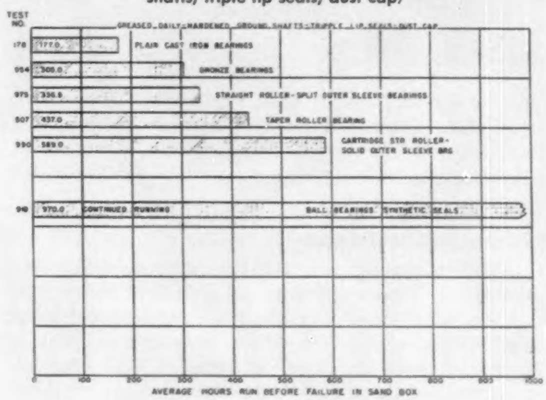


Table 3 represents the difference between bearings commonly used in farm implements. The first one on the chart is the plain cast iron bearing, which averaged 177.0 hr. All this group was run with dust cap, hardened ground shafts, 16 RMS finish and triple lip leather seals. The shafts were hardened to Rockwell 56C minimum and then ground to 0.8745 in. By this method the surface decarb from heat treating is removed. Surprising is the improvement in plain cast iron bearings when protected by good seals and shafts. The bronze sleeve bearings, as you can see, lasted 305.0 hr which is considerably better than cast iron. The straight roller bearings with split sleeves were only slightly better than the bronze bearings. The average life being 336.9 hr. Next in sequence is the taper roller bearings which ran 437.0 hr. One thing to remember when using taper bearings—the whole assembly is at the mercy of the man who adjusts the bearing. A looser running tolerance at the start will shorten the life of the seal. The best bearing in this group was the cartridge type straight roller bearing, which means a solid outer race. Average life in the test was 589.0 hr. Although not in this group, the results of sealed ball bearings are inserted here for comparison. The seals are synthetic rubber. At the time Table 3 was made all the ball bearings had passed the 970-hr mark. Since this time one vendor's ball bearing failed at 1034 hr.

TABLE 3 Analysis of bearings (greased daily, hardened ground shafts, triple lip seals, dust cap)



There is one class of bearings I did not show in Table 3, because we have not finished with their testing. These are plastic sleeve bearings. Our first samples were quite a disappointment as the bearings did not last as long as the plain cast iron. The heat generated caused the material to flow, closing the grease reservoir in the center. The two separated sleeves vulcanized themselves together. Later samples with a different running tolerance are doing better but do not

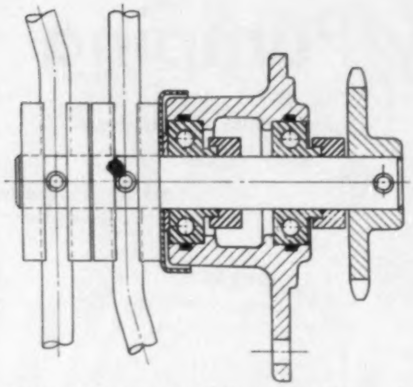


Fig. 6 A ball bearing installation using locking collars

cause much excitement. In all the above tests, the bearings, except the ball bearings, were greased daily or every 22 hr.

We ran another series of tests with straight roller bearings, split outer sleeves, ground shafts, triple lip seals and dust cap, 14 samples each, for comparison between daily greasing and bearings grease packed for the life of the bearing. Results were astonishing. These samples were not all run to complete failure, but were removed at various times and checked for wear. According to wear measurement on the shafts, rollers and outer sleeves, wear was two to three times more for bearings that were greased daily than for the packed bearings. At the present time we are repeating this test with six samples each. I repeat that from wear measurements versus time, the packed bearings would last twice as long as those bearings greased daily.

There are perhaps two reasons for these results. One, when the bearing is greased daily, excess grease is forced through the seal and comes in contact with the sand, thus forming a good grinding compound. Second, the seal seats itself on the shaft. Each time grease is forced through the seal, the lips are raised. Since there is some end play in the shaft, the seal must reseat or wear a new line contact on the shaft. These are only theoretical opinions in the analysis of why packed bearings would run twice as long as bearings greased daily as illustrated by this test.

Fig. 6 shows a ball bearing installation using locking collars. The black dot directly over the outer race is an "O" ring. The reason for the "O" ring is two-fold. With its use the outer diameter tolerance can be plus or minus one thousandth in. and looser. This type of bearing requires one bearing assembled on the shaft first. The bearing can be then assembled in the housing without damage to the bearings or seals. Since bearing has a lighter press fit, repair replacement is greatly facilitated.

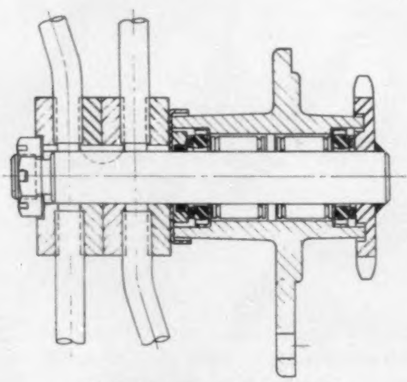


Fig. 7 An inexpensive face seal

The design in Fig. 7 incorporates an inexpensive face seal. We are still testing and improving this particular design, and only show the assembly now for what it is worth. The seal is pressed into the housing. The sealing face is to the outside.

Conclusions

I do not review these tests results to dictate the use of any particular bearing or seal combination. The choice of bearings and seals is entirely up to the design engineer to use the best economical combination that is good enough for his machine to meet competition.

There are other varied field operating conditions for consideration not included in this test which contribute to the third life factor of ignorance, such as type of lubricant, winding of material next to the seal, the overhang and load on the drive causing shaft deflection, manufacturing variations causing bearing misalignment and excessive moisture combined with the dust.

Salary Survey Report

SAID to be the most comprehensive report on salaries of engineers ever published in the United States will be issued by Engineers Joint Council this month, according to D. S. Bridgman, chairman of the EJC Surveys Committee. Based on a survey conducted by the Engineering Manpower Commission of EJC, the study will present salary structures of close to 800 companies and government organizations, grouped by principal product or service. The breakdown will include some twenty industrial activities as well as municipal, state and federal government. Data on over 5,000 engineering faculty members will also be featured. Special tables will be presented on engineers with master and doctorate degrees.

The data will be derived from what is said to be the largest sample ever studied including some 150,000 engineers in all activities. Price is $3.00 a copy, quantity discounts on request. Copies may be ordered from Engineers Joint Council, 29 West 39th St., New York 18, N. Y.

Machine Design Awards

THE James F. Lincoln Arc Welding Foundation of Cleveland, Ohio, is offering 54 awards totaling $50,000 for papers describing the use and advantages of arc welding in the design and construction of machines or machine components. Top award to the author or authors of the best paper is $10,000. Papers may describe how a machine is improved or reduced in cost through the redesign of a casting to a weldment, the redesign of an existing weldment, or the design of a new weldment. Weldments used in practically every type of industrial machinery are eligible. The competition is open to all persons in the United States or its possessions. The rules booklet is available from the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. Contest closes July 20, 1959.

Farm Drainage by Pumping

An engineering survey of typical drainage pumping installations in Michigan and the outlook for growth of the practice

Robert A. Sanderson
Member ASAE

Karl R. Klingelhofer
Member ASAE

THERE are many acres of wet but potentially good cropland in Michigan that are not fully utilized for lack of good natural, gravity drainage outlets. Some of the acreage has not been farmed recently; some has been left undrained for various reasons and in other areas recent drainage improvements have been limited. It is estimated that there are approximately 400 pumping plants in operation draining 45,000 acres, of which 12,500 acres are drained by two plants. Approximately one-third of the total area requires only pumping of tile drainage water. The other two-thirds requires pumping of both tile and surface water.

The U.S. Soil Conservation Service does not furnish technical assistance on practices for which the primary purpose is to bring additional land into production or on practices that destroy important waterfowl habitats. However, pump drainage does have a place in the basic SCS goal of using each acre of land according to its capabilities and treating it within its needs through the development of the "basic farm conservation plan."

Fig. 1 Typical 10-in. propeller pump manufactured in local farm machine shop

Fig. 2 Typical surface water pumping installation 16-in. locally made propeller pump powered by 15 hp 3-phase electric motor located on Stork Ranch, Saginaw Soil Conservation District

SCS technicians in Michigan have assisted many farmers on the design of the farm pumping plants. Usually these jobs involve the installation of a pumping station to improve existing drainage outlets on land that has been under cultivation for some time but with limited returns. Frequently pump drainage allows a farmer to establish a conservation rotation on land that was previously subject to spring flooding or at least very poor internal drainage. Before pump drainage, the farmer would gamble on the weather and plant short season cash crops each year with harmful effects to soil structure.

Farm drainage pumping in Michigan is predominantly by small pumping plants in contrast to large ones along the Illinois and Mississippi Rivers. These plants are usually individually owned. The average size farm pumping plant provides an outlet for 80 acres. A number of these plants drain acreages as small as 10 with several up to 320 acres. The two largest pumping plants are located in the Saginaw Valley, one of which drains 8,000 acres and the other 4,500 acres.

The use of pumping equipment to provide better farm drainage in Michigan is believed to have originated in the Saginaw Valley over 50 years ago. The first private farm pumping plant known to have been operated in this area was just north of Saginaw. This was rather a crude waterwheel type of plant that was installed about 1925 and used until about 1935 when replaced with a propeller-type pump. Farm pump drainage really gained momentum during the period of 1935 to 1938 when the Lake Huron level started rising. Much of the good farm land in this area is near lake level and became subject to flooding or at least had very poor gravity drainage with the rise in lake levels. The Lake Huron level peaked at about 583 ft above sea level in 1951, and many farmers pumped from blocked-off open ditches. Lake Huron level is now down to 579.36 ft (1)*. Also, just prior to this period there was a movement under way to capitalize on the many acres of marsh land in the area. First, the native grasses were cut for hay and sold. Then this land was gradually broken up and cultivation

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Paper presented at the Golden Anniversary Meeting of the American Society of Agricultural Engineers at East Lansing, Mich., June 1957, on a program arranged by the Soil and Water Division.

The authors — ROBERT A. SANDERSON and KARL R. KLINGELHOFER — are, respectively, area engineer and interarea engineer, Soil Conservation Service, U.S. Department of Agriculture.

Acknowledgment: The authors acknowledge the helpful assistance of farmers, electric power companies, pump manufacturers, and Soil Conservation Service personnel in the preparation of this paper.

*Numbers in parentheses refer to the appended references.

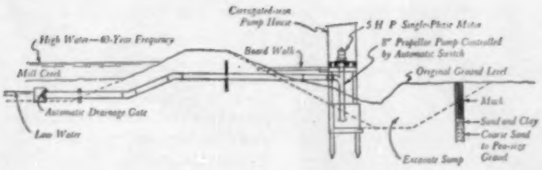


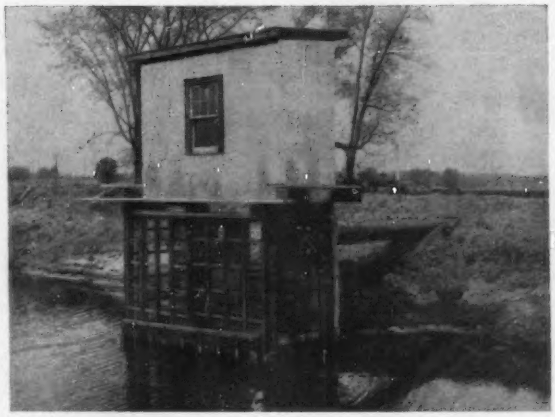
Fig. 3 Pumping station located on Van Den Berg farm in Lapeer Soil Conservation District

started. Because of its high productivity, the land owners would not abandon this land when the lake levels rose, and therefore they had to start pumping for drainage.

About 1940 the locally made propeller pump (in the Saginaw Valley) and the helical-type pump (in the Muskegon area) began to appear in numbers. The helical pump was used by the celery growers for low-lift pumping. Also, in the 1940's a number of farmers, especially on the western side of the state, began using second-hand, centrifugal-type pumps purchased from local industrial companies. These pumps were designed for high heads in excess of 80 to 100 ft and were doomed to failure because of low efficiency when applied to farm pump drainage. Because the problems were not understood, many farmers gave up in disgust after paying excessive power bills. The revolving belt with cleats or buckets on an inclined plane was also used in the early 1940's but has been almost completely abandoned because of its inefficiency.

During this period farmers thought they could not afford the cost of commercially made pumps manufactured by some of the large pump companies and experimented on their own. The outcome was that several farmers with mechanical ability first made pumps for their own farms and then began making pumps for their neighbors. One farmer produced 130 pumps during the period 1940-1955 in his farm work shop. This was a one-man operation with most of his production occurring during the winter months. He has now turned over his operation to a local commercial organization and they have produced an additional 50 pumps.

There are at least six of these local fabricators making more than 10 pumps per year in the Saginaw Valley and two on the west side of the state. It is estimated that there



are 300 of these locally made pumps in operation in a four-county area, plus 100 more in the rest of the state.

The majority of these pumps were of the propeller type (axial flow) in which the discharge pressure is developed entirely by the lift of the impeller blades. The water moves only along the axis of the propeller shaft and the pumping heads are usually limited to ten feet, especially on the locally made pumps. With additional stages and better design, commercial companies have produced pumps for considerably higher heads without too much loss in efficiency. Now that the lake levels are lower, many areas are troubled only with outlets for tile drainage and the pumps are being adapted for operation in a sump with the pump being electrically powered and automatically controlled. This is where the greater efficiency of the commercially made pump is bringing it back into competition.

Other situations where pump drainage is used in Michigan are as follows:

1. Areas which cannot be readily drained by existing gravity outlets because the soils are unstable; an adequate outlet is too far away to be practical, or a property owner below objects to deepening the outlet
2. Areas where the cost of a gravity outlet exceeds the benefits received or where high water levels in nearby

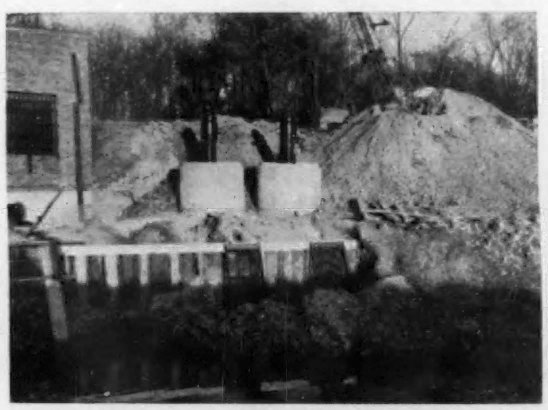


Fig. 4 Two 24-in. mixed flow pumps are shown during installation at Saginaw Valley Cooperative Farms Association pumping station, Saginaw Soil Conservation District

Fig. 5 A 6-in., 2-stage propeller pump powered by 2-hp single-phase motor is used for pumping 40 acres of tile water at the Martin Klebba farm pumping station. Pump is automatically controlled and installed in 12-ft diameter silo stave sump. Soil is shallow muck over clay

Water from a 280-acre watershed is pumped with a locally manufactured, 12000-gpm, 22-in. pump driven by a 3-phase 25-hp electric motor. Fig. 6 *(Left)* Shows discharge pipe from pump under low tail water operations • Fig. 7 *(Right)* Shows pump house and float control box

. . . Farm Drainage

lakes and streams make it impossible to provide adequate drainage

3 Areas which have special requirements for drainage, subirrigation, and irrigation that necessitate control of the water table to provide for proper management of muck or sandy land.

Areas being drained by pump drainage in west central Michigan are made up mostly of organic soils and the moderately coarse to coarse soils (mucks, sands and gravels), while in the east central part of the state the soils being pump-drained are mostly fine to moderately fine soils (silty clay loam to clay loam) with scattered organic and moderately coarse areas (loams and heavier with scattered areas of muck or sands).

The first pumping station designed by the Soil Conservation Service in Michigan was installed in 1947 on the Van Den Berg farm in Lapeer County. This installation provides an outlet for 58 acres of muck on which celery, potatoes, onions, and lettuce are grown. Field drainage is by open ditches and the crops are sprinkler irrigated. The pumping station is comprised of an 8-in. propeller pump powered by a 5-hp single-phase motor with a capacity of 1500 gpm against an average static head of 5 ft. The pump house and pump bay were constructed so that an additional 8-in. pump could be added if the farmer felt it necessary for maximum protection to high-value crops. So far one pump has been adequate. The annual power costs have been approximately $1.00 per acre per year.

The largest agricultural pumping installation in Michigan known to the authors has a drainage area of approximately 8,000 acres and is completely diked. The development of this area was started in 1903 by a sugar company. The first pumps were installed in 1903 and were steam powered. This area is only three to five feet above normal lake level even though it it located some 25 miles from Saginaw Bay. It is also in a poor position because four rivers come together in a marsh area just below it. All surface and tile water is pumped from the area. The pumping equipment is comprised of two 24-in. vertical mixed-flow pumps and two 36-in. horizontal mixed-flow pumps with a combined capacity of approximately 70,000 gpm. The 24-in. pumps are powered by 50 hp, 3-phase motors and automatically controlled. The 36-in. pumps are powered by 120-hp diesel engines and are used for standby service and peak pumping seasons. One of the 36-in. horizontal mixed-flow pumps is being replaced with a 36-in. vertical mixed-flow pump powered by a 100-hp electric motor. The new pump will have a capacity of 30,000 gpm. The horizontal mixed-flow pumps have been in service since 1924 and now require considerable maintenance, especially the engines. The average static head is approximately 10 ft.

This area, locally known as the Big Prairie, is made up of 22 privately owned farms and is incorporated under the name of Saginaw Valley Cooperative Farms Association, only for the purposes of maintaining the drainage and diking facilities. Even though the area has a pumping capacity of approximately ½ in. per 24 hr, it has experienced little difficulty from heavy rains. The surface soil is quite permeable with the over-all profile being classified as moderately fine to fine (clay loam to silty clay). Practically the entire area is tile drained, which provides quite a reservoir within the soil.

The annual operating cost for this 8,000-acre installation has averaged 65 cents per acre per year (not including depreciation or interest on investment) for a five-year period.

The design of individual farm pumping plants by the Soil Conservation Service in Michigan follows very closely those which have been previously described in AGRICULTURAL ENGINEERING. Therefore, discussion here will deal briefly with design criteria and procedure. The pumps

Fig. 8 *(Left)* A 4-in. pump driven by a ¾-hp, capacitor type, 115-volt electric motor delivers 90 gpm at a 4½-ft lift in a 20-acre watershed drained by random tile lines • Fig. 9 *(Right)* A 12-in. pump, driven by a 7½-hp, single-phase electric motor, was installed in a 140-acre watershed. Later a 10-in. pump driven by a 5-hp electric motor was added

which handle only tile water are designed to handle maximum flow from the tile, and the sump is designed with a large enough storage volume to keep the pump motor from cycling more than five times per hour for automatic operation. Our surface water pumping installations are usually designed for the removal of ¾ to 1 inch of water per 24 hr. One of our biggest problems is in calculating the maximum discharge of a tile main and the total volume of flow from a tile main as related to various soil types. It would certainly be desirable to see more research along these lines.

The use of silo staves for circular sump walls on individual farm automatic pumping stations has gained ready acceptance. Approximately twenty of these silo stave sumps have been constructed in the last three years. The diameter has ranged from 10 to 16 ft and the depth ranged from 7.5 to 10 ft. The average cost for materials and excavation for a 12-ft-diameter sump, 10 ft deep has been approximately $300. The construction is relatively simple and can easily be handled by farm labor. The biggest problem has been getting them started at the proper elevation and providing enough supervision so they do not end up egg-shaped. So far all the sumps have had a concrete floor with a minimum thickness of 4 in. To date the use of silo staves seems to be the most practical method for sidewall construction of sumps. By not mortaring the joints of the silo stave walls, the problem of buoyancy has been avoided. We have one poured concrete circular sump put in by a silo company that looks quite satisfactory. Weep holes were put through the sidewalls to reduce danger of buoyancy. From a safety angle we feel it is most important to install a ladder in the sump as soon as the hole is excavated and to provide a good cover upon completion. One farmer almost drowned after falling into a sump that had 7 ft of water in it. Because of the excess moisture and summer heat, proper ventilation in the pump houses has been found important.

Pumping Costs

The following information(2) gives the cost of electric power for 53 pumping plants in the vicinity of Muskegon, Mich. The area of muck land drained by these plants is 527 acres; the average size installation serves practically 10 acres.

Year	Total Acreage Pumped (Acres of muck not total drainage area)	Acreage Pumped (Growing and harvesting season only)†	Acreages Pumped (Throughout the year)‡	Average Cost (Electric power per calendar year per acre)
1943	230	230	None	$3.95
1944	450	220	230	$5.75
1945	527	230	297	$8.10

†Average power consumption (growing and harvesting) 110 to 115 kilowatt hours per acre.
‡Average power consumption (throughout the year) 220 to 230 kilowatt hours per acre.

Ten pumping plants that pump only tile water from sumps were selected in the Saginaw Valley for evaluation of pumping costs. Of these ten, only four were able to provide reliable power cost figures for 1956. The total drainage area being pumped by the ten plants is 614 acres, or an average of 61.4 acres per pumping plant. The significant data on the four plants observed during 1956 is as follows:

Drainage area pumped	58¼ acres
Average cost of power per acre per year	$1.11½
Average number of kilowatt-hours per acre per year used	25.6

(NOTE: The number of kilowatt-hours used was not available for one of the plants.)

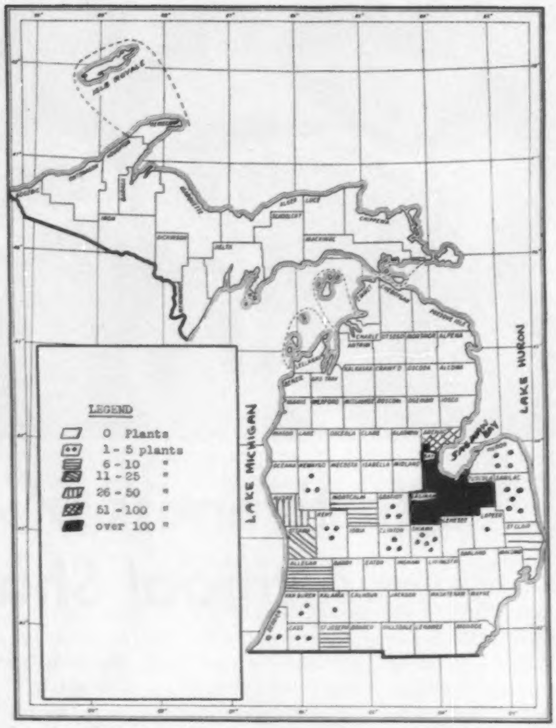


Fig. 10 Distribution of farm pumping plants in Michigan (June 1957)

Seven pumping plants that pump surface water plus tile water were selected in the Saginaw Valley for evaluation of pumping costs. Of these seven only four were able to provide representative power cost figures. The total drainage area being pumped by the seven plants is 14,249 acres, or an average of 2,036 acres per plant. Three of these plants are corporation-type operation (in excess of 1,000 acres per plant and engine-driven-type plants in two cases). The significant data on the four plants studied is as follows:

Drainage area pumped (acres)	247 (average)
Cost of power per acre/year	$1.13

(NOTE: Number of kilowatt-hours used was not available for one of the plants.)

In 1953 four plants pumping surface water, serving a total of 253 acres of land in southwestern Michigan provided the following data:

Drainage area pumped (acres)	83 (average)
Cost of power per acre per year	$0.69
Kilowatt hours per acre per year	12.5

The authors found that each power company has its own policy on line extensions, minimum monthly rates, and service installation charges as applied to farm pumping stations, some being much more favorable to the farmer than others. Even though the initial cost of the station may be reasonable, the power costs may be prohibitive.

The minimum monthly rate is especially important because most installations use less than that allowed on the monthly minimum six months out of the year. The number of acres drained by one plant is important. On installations

(Continued on page 766)

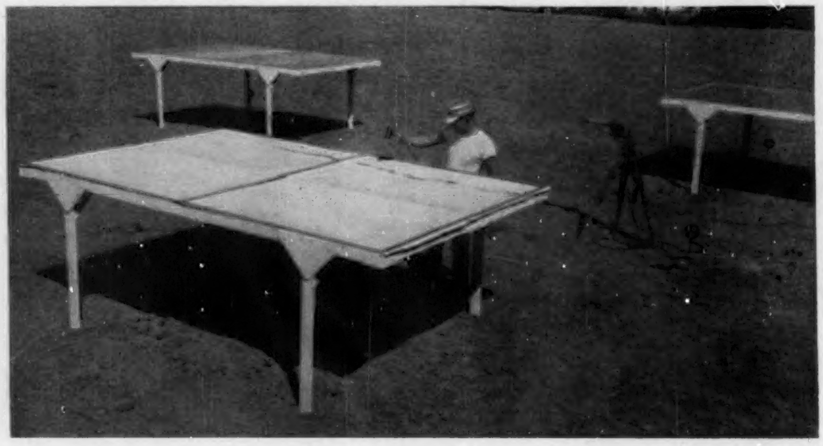


Fig. 1 Shade frames 8 x 12 x 4 ft high covered with test materials. Note directional radiometer for measuring radiation from material, flat-plate radiometer for measuring upper hemisphere radiation, and 6-in. black-globe thermometers for measuring spherical radiation

Effectiveness of Artificial Shade Materials

C. F. Kelly and T. E. Bond
Fellow ASAE Member ASAE

Results of studies on the effect a shade material has on the radiant heat load beneath

UNDER a cooperative research project between the University of California and the U.S. Department of Agriculture, the following problems relating to artificial shade for livestock have been studied: the relation of color of surface to temperature of material(1)*, the geometrical design of shades with respect to shape and space and the resulting radiant-heat loads(2), and the effect of various kinds of shades upon the well-being of beef cattle (3). This paper presents the results of studies on the effect of the shade material upon the radiant heat load beneath it. (All shades were without walls.)

Some of the properties of materials which affect their efficiency as open shades are:

1 Transmissivity and reflectivity of upper and lower surfaces for radiant energy of all wave lengths

2 Thermal diffusivity (including heat capacity, density, and thermal conductivity)

3 Nature of the surface for heat transmission by convection

4 "Solidness" or percentage of the area that is open.

These properties are so interrelated and so affected by the rapidly changing solar and sky radiation, air velocity and temperature, and ground temperature and radiosity, that a field study attempting to correlate all factors for a considerable number of materials is very difficult. For instance, a comparison of a concrete slab with a thin metal sheet involves a large temperature lag in the concrete, depending upon its thickness, the aggregate used, etc., and a very short temperature lag in the metal, even if all conditions of weather, solar and sky radiation, and material reflectances are exactly the same at the time the comparisons are made. In these field studies the differences were integrated by using globe thermometers(4), and the materials were rated for effectiveness by comparison with new, bright corrugated aluminum sheets, 0.019 in. thick.

The effectiveness of a shade material was determined as follows:

1 Comparative observations of black-globe thermometer temperature, air dry-bulb temperature, and air velocity, were made in the sun and at the center of the shadow cast by thin shades 8 x 12 x 4 ft high, three or four shades being observed at the same time (Fig. 1). One shade was always of new, bright corrugated aluminum, 0.019 in. thick. The centers of the globe thermometers and other sensing elements were 18 in. above the ground. Observations were made at half-hour intervals on clear, bright days, 10 a.m. to 3 p.m., during the hot summer months. The shades were located in an area recently plowed or disked, with no green vegetation. The globe thermometers were moved each half hour to the center of the moving shadows. The 8 x 12 ft shades were oriented with the long axis east and west, and the materials that were corrugated or otherwise deformed had the corrugations extending north and south. Table 1 gives the observations made during a typical day.

Paper presented at the Annual Meeting of the American Society of Agricultural Engineers at Santa Barbara, California, June 1958, on a program arranged by the Farm Structures Division.

The authors — C. F. Kelly and T. E. Bond are, respectively, professor of agricultural engineering, University of California, Davis, and agricultural engineer, livestock engineering and farm structures branch (ARS), U.S. Department of Agriculture.

*Numbers in parentheses refer to the appended references.

2 The hourly globe thermometer and dry-bulb temperatures and air velocity measurements were used to calculate mean radiant temperature *(MRT)* and radiant heat loads *(RHL)*, using the charts published in AGRICULTURAL ENGINEERING by Bond(4). The radiant heat loads were averaged for each material. (Table 2 shows these calculations for the same typical day.)

3 The effectiveness *(E)* of each sample of material was determined by the following relation:

$$E = RHL\ (\text{sun}) - RHL\ (\text{sample}) / RHL\ (\text{sun}) - RHL\ (\text{aluminum})$$

The values of *E* for the 35 materials investigated are listed in Table 3, in descending order of effectiveness, along with the treatments of materials, number of days each material was observed, and the actual average spherical radiant heat load.

Since the spherical radiant heat load in the sun appears in both the numerator and denominator of this equation, it serves as a common reference point for sample and standard material, and also allows differences in solar and sky radiation from day to day to be at least partially accounted for.

By always using shades of the same size, height, and orientation, the sky horizon, hot ground and shadow always have the same shape factor with respect to the globe under each shade. At a given time, the radiosities of these parts will be the same around any particular shade, and the radiant heat loads will be similar except for the effect of the shade material. On days with different amounts of solar and sky radiation, and with different dry-bulb temperatures and air velocities, the use of the "standard" aluminum allows comparison among different materials.

Because the radiosity of the shade depends somewhat on the reflectivity of its lower surface for various wave lengths(1, 2), the nature of the surface over which the shade is constructed will affect the resulting radiant heat load. However, in these tests the ground, always freshly plowed and black, imposed a greater load on the under side of the shade and upon the globe directly than any other type of ground cover studied, and it is felt that the comparisons among the materials are made more precise by the inclusion of the lower hemisphere through the use of a spherical sensing element. In other words, over a green ground cover the radiant heat load for all materials would have been less, but the comparative order of effectiveness (which is the objective here) the same.

The shape factor of the shade—and, of course, also the shadow—with respect to the globe will remain the same as long as the proportions of the shade are maintained constant. Thus test shades 8 x 12 x 4 ft high will result in the same radiant heat load on a globe 18 in. above the ground at the center of the shadow as if all dimensions were doubled (16 x 24 x 8 ft high with globe 3 ft above the ground). The enlargement or extrapolation should probably not be carried farther because of variations in radiosity over the shaded ground.

The results in Table 3 indicate a large span or range between materials of the highest and lowest effectiveness (although within the extremes some of the differences are insignificant). For instance, two very popular materials in California beef and dairy lots (very often used in the same lots) are hay and snow-fencing. These are at opposite ends of the effectiveness scale—1.203 for hay and 0.589 for snow fence. This represents a difference in radiant heat load of 61 Btu per hour per square foot of animal surface, or, for a 1000-lb cow with a surface area of 50 sq. ft, a total difference of 3050 Btu per hr, the equivalent of the evaporation of about 3 lb of water. *(Continued on page 764)*

TABLE 1. GLOBE THERMOMETER, AIR TEMPERATURE, AND AIR VELOCITY OBSERVATIONS MADE JULY 22, 1957, AT DAVIS, CALIFORNIA, IN SUN AND UNDER SHADES OF FOUR DIFFERENT MATERIALS.

Time	Air temp.	Air velocity	Globe thermometer temperatures				
			In sun	Under* aluminum	Under† snow fence	Under‡ asbestos board	Under§ plastic film
	F	Ft./Min.	F	F	F	F	F
11:00 a.m.	85.0	174	116.0	89.8	101.0	91.5	99.0
11:30	89.1	138	121.0	93.5	102.5	94.5	101.5
12:00	91.5	360	114.0	93.5	104.9	94.5	101.8
12:30 p.m.	93.0	282	123.0	96.6	108.0	98.0	104.9
1:00	92.5	366	123.0	98.5	110.5	99.0	106.7
1:30	96.0	288	127.0	99.0	105.5	100.5	107.8
2:00	96.5	210	127.0	101.0	110.0	101.0	110.0
2:30	99.0	135	129.0	103.0	115.5	104.3	112.0
3:00	97.5	252	123.0	102.6	117.5	103.0	109.0

*New bright corrugated aluminum sheets, the standard for comparison.
†Snow fence, single thickness, 1/4" x 2" slats spaced 2" apart.
‡1/8" thick, unpainted.
§Polyethylene, white, (not translucent) 2 mil. thick.

TABLE 2. RADIANT HEAT LOADS (RHL)* AND EFFECTIVENESS (E) OF THREE SHADE MATERIALS, AS COMPARED WITH NEW ALUMINUM SHEETS, FOR OBSERVATIONS MADE JULY 22, 1957 (LISTED IN TABLE 1).

Time	In direct sun	Aluminum (standard)	Snow fence		Asbestos board		Plastic film	
			RHL	E	RHL	E	RHL	E
	Btu hr sq ft	Btu hr sq ft	Btu hr sq ft		Btu hr sq ft		Btu hr sq ft	
11:00	263.1	168.8	208.8	.58	175.1	.93	201.7	.65
11:30	263.7	171.4	201.1	.68	174.7	.96	197.8	.71
12:00	264.3	168.9	221.5	.45	173.5	.95	207.2	.60
12:30 p.m.	289.6	176.6	224.9	.57	182.6	.95	211.6	.69
1:00	303.6	188.4	244.0	.52	190.7	.98	226.5	.67
1:30	298.1	177.7	208.2	.75	185.1	.94	214.9	.69
2:00	296.6	182.7	217.1	.70	182.7	1.00	217.1	.70
2:30	269.9	182.0	223.5	.53	186.2	.95	212.0	.69
3:00	271.6	187.6	228.0	.52	189.2	.98	213.4	.69
			Average	.589		.960		.677

*RHL (Spherical radiant heat load) determined from globe thermometer and dry-bulb temperatures, and air velocities as listed in Table I, by use of charts prepared by Bond (4).

TABLE 3. SHADE MATERIALS LISTED IN DESCENDING ORDER OF EFFECTIVENESS, AS COMPARED WITH NEW CORRUGATED ALUMINUM

Material	Treatment	Days* Observed	RHL †	Effectiveness
Hay	6" thick	1	150	1.203
Aluminum	Top white, bottom black	5	160	1.103
Aluminum	Top natural, bottom black	2	161	1.090
Galv. Steel	Top white, bottom black	5	163	1.066
Louvres (wood)	Unpainted	1	164	1.060
Galv. Steel	Top white, bottom natural	3	165	1.053
Aluminum	Top white, bottom natural	4	165	1.049
Neoprene nylon ‡§	Top aluminum, bottom black	1	165	1.048
Lovres, wood	Top unpainted, bottom black	1	166	1.042
Polyethylene, 8 mil film	Black, double layer, 2" spacing	2	166	1.036
Plywood, 3/8" thick	Top white, bottom unpainted	2	167	1.031
Plywood, 3/8" thick	Unpainted	2	167	1.030
Plywood, 1/4" thick	Unpainted	3	167	1.030
Polyethylene, laminated ‖	Top white, bottom black	6	167	1.028
Neoprene nylon ‡¶	Top aluminum, bottom black	3	168	1.022
Aluminum	Standard	20	170	1.000
Aluminum	One year old, unpainted	1	171	0.994
Galv. Steel, new	Unpainted	5	171	0.992
Galv. Steel,	One year old, unpainted	1	172	0.985
Louvres, wood	Black top, black bottom	1	173	0.970
Aluminum	Ten years old, unpainted	2	173	0.969
Asbestos Board	1/8" thick, natural color	2	174	0.956
Building Paper	Aluminum coated	2	175	0.950
Hardboard	1/8" thick, plain (Masonite)	2	176	0.942
Neoprene nylon ‡§	Thin, black	1	176	0.940
Neoprene, nylon ‡¶	Thick, black	3	177	0.933
Snow Fence **	Double layer, no openings	1	177	0.933
Saran Shade Cloth ††	(92% solid)	1	177	0.926
Saran Pool Cover Cloth ††	– – –	1	181	0.889
Polyethylene 8 mil film	Black	1	183	0.868
Saran Shade Cloth ††	(90% solid)	1	187	0.839
Snow Fence **	Double layer, criss crossed	1	188	0.823
Polyethylene 8 mil film	Translucent	1	193	0.774
Polyethylene 4 mil film	Translucent	1	202	0.677
Snow Fence **	Single layer	1	211	0.589

*Days of continuous records, 11:00 A.M. until 3:00 P.M.
†Spherical radiant heat load (Btu/hr. sq. ft.) under shade.
‡Furnished through courtesy E. I. duPont de Nemours Company, Wilmington, Delaware.
§Lightweight (10 oz sq yd) neoprene-coated nylon.
‖Furnished through courtesy Bakelite Corporation, New York.
¶Heavyweight (16 oz sq yd) neoprene-coated nylon.
**Snow-fence slates 2" wide, spaced with 2" openings.
††Furnished through courtesy of Chicopee Manufacturing Company, Lumite Div., Cornelia, Georgia.

Minimizing Off-Flavors of Irradiated Foods

Mass preservation of perishable food by ionizing radiations could change the entire food industry. But before this happens, problems of unpleasant tastes and odors in the treated foods must be solved

Aaron L. Brody

ALTHOUGH microbicidal effects of ionizing radiations have been known since the turn of the century, applications of these effects to food preservation awaited the availability of relatively inexpensive radiation sources resulting from nuclear bomb development. For the past decade, intensive investigations have repeatedly shown that food can be sterilized by ionizing radiations. Food thus treated maintains indefinitely the condition in which it emerges from the radiation source. However, in addition to destroying those factors responsible for food spoilage, ionizing radiations also cause side effects which manifest themselves as off-flavors and as texture and color losses in foods.

These side effects are the largest single problem to be solved before radiation preservation can become a practical food preservation technique. Possibly consumers will accept radiation flavored foods in much the same way as they have accepted pasteurized milk or canned food flavors. If they do not, then a means must be available to retain natural flavor.

Many methods have been proposed, but no single technique appears to be an all-encompassing answer. Some hold promise as a partial answer. Many observers feel that radiopasteurization offers the most immediate approach to limited commercial application of radiation preservation. Since low temperature is required in storage, the use of refrigeration will thus be expanded if and when radiation preservation becomes a commercial reality.

Cause of Side Effects

Desirable effects of ionizing radiations result from breaking biochemical bonds within microbial cells. Since microbes and foods have virtually identical biochemical components, ionizing radiations also have the ability to alter biochemical configuration of foods. Neither radioactive nor machine source radiations have the ability to discriminate between a desirable flavor, color, or odor molecule and an undesirable microbe. During irradiation, both are disrupted to a greater or lesser degree.

Research has shown that on the order of 10^8 ergs per gram are required for microbial destruction. This energy could break on the order of 10^{18} bonds per gram, or about 0.003 percent of the bonds present. Although these changes are small, they are sufficient to cause microbiological destruction and also detectable and often objectionable organoleptic changes in foods(1)*. Actually, about 10^5 times less energy applied to the food could theoretically destroy microorganisms if this energy could be directed exclusively to the desired sites. In other words, 10^5 times the energy required for microbial death is used for radiation sterilization, with the excess energy being absorbed by desirable food molecules and causing side effects(7).

Minimization of Side Effects

Investigation of side effect causes has isolated and identified many responsible components and their precursors, but, more significantly, these studies have indicated that the problem is as complex as that of natural food flavors. Most efforts have been devoted to prevention of formation of off-flavors, although at least one promising means of removing off-flavor compounds after they have been formed has been developed. Among the preventative means proposed are altering sources and source levels, controlling the irradiation environment, using of additives, and using adjuncts.

Radiation Sources

Many factors are involved in selection of a radiation source: cost, down time, product dimensions, shielding, etc. There has been much controversy over relative bactericidal effectiveness and side effect production of gamma versus cathode rays at various levels(4). Until this question is settled, effects produced by commonly used gamma and cathode ray sources must be considered essentially similar.

There is some evidence that very high dose rates and irradiation times of fractions of a second would give greater biological and fewer side effects. This combination can be achieved only with machine sources, particularly pulsed beam units such as the capacitron. Results in this area are also controversial and inconclusive (4, 11).

At least one group of investigators has shown that ground beef subjected to intermittent gamma ray treatments suffered significantly less off-flavor development than a similar product given an identical radiation dose in one treat-

*Numbers in parentheses refer to the appended references.

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The author — AARON L. BRODY — is research food technologist, Research Laboratories, Whirlpool Corp., St. Joseph, Mich.

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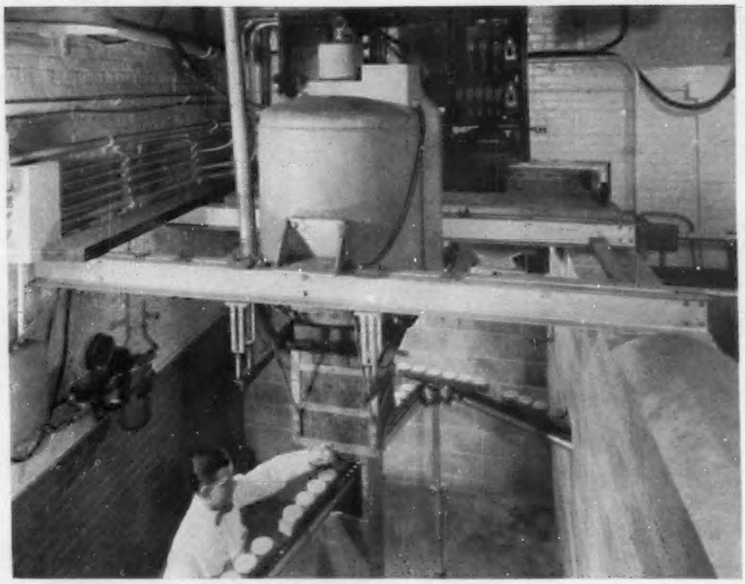

Fig. 1 Resonant transformer electron accelerator used to irradiate samples (Photo courtesy X-ray Dept., General Electric Co.)

ment(2). This method involved repeated exposures to short bursts of ionizing radiations with several-hour time intervals between exposures.

In general, foods are effectively sterile throughout most of their volume. Microorganisms are found only in localized sites, often the surface. Surface irradiation would, therefore, effectively destroy most spoilage organisms without causing irradiation damage to the bulk of the food(4). Side effects encountered with high energy irradiation of foods are not induced with 60 kilovolt X-rays for two reasons: these low level radiations do not have sufficient energy to penetrate much below the surface of the food, and "there are theoretical reasons for believing that soft X-rays are at once more effective against microorganisms and less effective in instigating side reactions"(8).

A number of high energy units for surface sterilization have been developed. In effect, these units rotate irregularly shaped foods, such as peaches and potatoes, in the path of an ionizing radiation beam having low penetrating power. Although relatively few radiation side effects have been observed, considerable damage to the product from handling during radiation processing has been noted on occasions(6).

Environmental Conditions

Most irradiation reactions arise not from direct effects of irradiation but from the formation of free radicals by ionizing radiations. Free radicals, in turn, react with biochemical bonds to give both desirable and undesirable effects. Inhibiting free radical reactions results in a lessening of side effects. Free radical action can be prevented by changing environmental conditions during irradiation, by preventing their formation, or by deliberately reacting them to form innocuous compounds.

If food is irradiated in the frozen state, the rate of diffusion of free radicals is greatly reduced thus reducing their ability to react and form off-flavored compounds. Dosages required for desirable effects are necessarily increased in the frozen state, but it has been noted empirically that side effects are reduced for any given dose(3).

Some free radicals, especially those responsible for oxidative changes, result from action of radiation on oxygen in the atmosphere surrounding the food. Irradiation in vacuum or in inert atmospheres removes oxygen necessary for formation of these oxidative free radicals.

Additives

Many materials preferentially react with free radicals to form innocuous compounds. Free-radical acceptors having a greater affinity for free radicals than for the compounds being protected include ascorbic acid and butylated hydroxyanisole (BHA)(12).

Fig. 2 Food sample being lowered into cylindrical cobalt 60 source (Photo courtesy Food Technology Department, MIT)

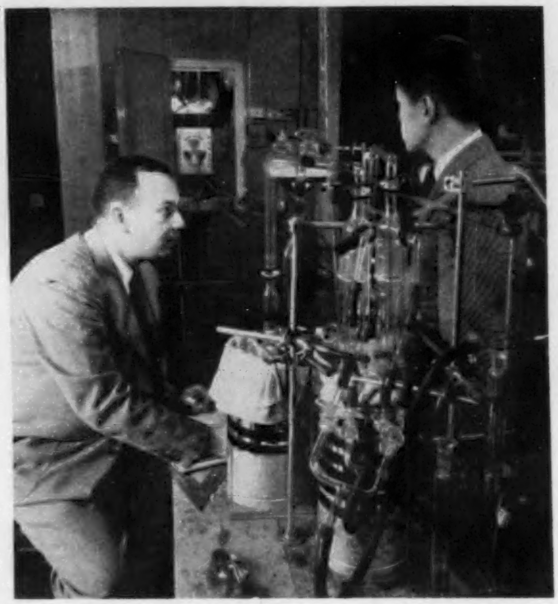

Fig. 3 Apparatus used to distill off volatiles during gamma irradiation of milk (Photo courtesy Food Technology Department, MIT)

Many unpublished reports review the masking effect of spices, seasonings, and condiments on irradiation off-flavors. The application of antibiotics to food preservation problems has been increasing in recent years. Some studies indicate that antibiotics and radiation can supplement each other in bactericidal effect, thus allowing for lower doses of both radiation and antibiotics and reducing side effects.

Adjuncts

Radiation combined with other processing methods may offer the most promising approach to commercial food preservation. All food preservation methods cause some alteration in the product. By combining food preservation processes, desirable preservation properties may be obtained with a minimum of undesirable alterations.

Most free radicals are formed by interaction of ionizing radiation and water. Removal of water (dehydration) prevents free radical formation. Application of irradiation to dried foods has not been particularly effective, however(4).

One of the most widely used food preservation methods is heat, which destroys enzymes and microorganisms with considerable thermal damage to the food. Combinations of heat and radiation offer several advantages. Enzymes are heat sensitive but radio-resistant. Destruction of enzymes by radiation results in grossly damaged products, but enzymatic activity in foods leads to rapid deterioration. Sufficient blanch heat to destroy enzymes also destroys some microorganisms with relatively little heat damage. Remaining microorganisms can be killed with small radiation doses which cause relatively little radiation damage(4).

The use of radiation as an adjunct to heat processing also has been considered to reduce the total heat process necessary to sterilize a product. Pure culture studies indicate that irradiation can increase heat sensitivity of microorganisms and that heating can increase their radiation sensitivity(5). These facts may be applied to reducing either the amount of heat or the amount of radiation required to attain a specific preservation level with minimum side effects.

Recognizing the direct relationship of radiation dose to both side effects and bactericidal effectiveness, it is evident that lower doses impart fewer side effects to a food, but also may fall short of sterilization. Further, lower doses do not destroy enzymatic activity. Other provisions, such as heat, must be made for retarding enzymatic activity in storage.

Both enzymatic and microbiological activity are temperature dependent and decrease with decreasing temperature. Refrigeration is therefore a possible adjunct to radiation. Probably the most promising approach is that of radiopasteurization, which makes use of low doses of radiation supplemented by refrigerated storage. The radiation destroys most, but not all, microorganisms present. Refrigeration retards further enzymatic and microbiological activity in storage. In this manner, foods with minimum amounts of radiation damage can have their refrigerated shelf life extended for prolonged periods.

Concurrent Radiation Distillation

The above methods describe techniques for preventing side effects. At least one promising method has been developed for removing off-flavors after they are formed. By concurrent use of radiation and distillation, a liquid such as milk can be given a sterilizing radiation dose while, simultaneously, volatile off-flavors are distilled off under reduced pressure. Organoleptically acceptable milk has been produced by this method at doses far above normal radiation threshold(9).

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Fluid Heat Meter

Charles N. Hinkle
Assoc. Member ASAE

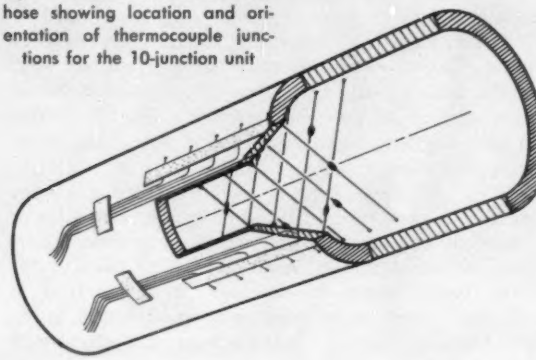

Fig. 1 Schematic section of rubber hose showing location and orientation of thermocouple junctions for the 10-junction unit

THE USUAL method for determining the amount of heat picked up by a circulating liquid involves measuring the temperature of the liquid before and after passage through the object being cooled and determining the weight rate of flow of the liquid. These measurements in conjunction with the specific heat of the liquid will give the amount of heat in such units as Btu's per hour picked up by the circulating liquid.

When the amount of heat to be picked up by the coolant is small, the temperature difference across the object being cooled is to be a minimum, or the physical properties of the fluid (*i.e.*, temperature, specific gravity, viscosity, etc.) are not known, determination of heat pickup by the above method can introduce considerable error in the results. The following described method which is not restricted by the above points is based upon the Thomas meter principle used for determining the weight rate of flow of gases. This method was used to measure small heat gains in a circulating liquid with entrance and exit temperature differentials of less than one degree.*

The major components of this system consist of two thermopile units suitable for use in the circulating liquid, a submergible plug heater comparable in size to the average expected heat gain, a voltage regulator, an ammeter and voltmeter or wattmeter of suitable range, and a manual potentiometer such as the Leeds and Northrup No. 8662. The majority of this equipment, especially the instruments, are already available among the research equipment at most agricultural engineering departments.

The following method was used for constructing the thermopile units with a 10-junction unit used around the object to be cooled, in this case a cold plate, and a 20-junction unit used around the plug heater. The 10-junction unit was made by installing 10 thermocouples in the center inch of a 4-in. piece of 1¼-in. reinforced rubber hose (Fig. 1). The 30-gage wires were threaded through the hose sidewall with a needle so as to place two junctions in the center of the hose and two each at ½-radius distance from the center on 90-deg. arcs. Spacing between the wires was ¼-in. which made the thermocouple junctions always more than ½ in. apart. The rubber held the wires tight and several coats of plastic cement were applied to the spots where the wires passed through the rubber to prevent leakage.

Two, 10-thermocouple units were made and used with hose clamps to connect the 1¼-in. outer diameter copper tubing of the cold plate to the 1-in. supply lines. Two sets of five thermocouples in each unit were connected together to form two, 5-junction thermopiles with the cold junctions before the plate and the hot junctions after. The four leads were terminated at a 12-contact female connector. This made it possible to plug into and measure either of the 5-junction thermopiles or to use a copper jumper wire to add the two emf's together and use them as a 10-junction thermopile.

The 20-junction units were similar in construction to the 10-junction except that 20 thermocouples were used in each 4-in. hose length with four along the center line and two each located at ½-radius distance on 45-deg arcs. The two units were installed as shown by Fig. 2 with the thermocouples combined to form four, independent, 5-junction thermopiles. The plug heater, ½ in. in diameter and 2½ in. long, was inserted between the two thermocouple units in the center of the 1-in. pipeline. Set screws tapped through the sidewall of the pipe were used to position the heater. Electrical leads for the heater were brought out through the packing glands at the other two branches of the pipe cross. For operation, the entire unit was heavily insulated so that all the heat added by the heater would be absorbed by the fluid.

The eight leads from the four thermopiles were terminated at the same connector as the four leads from the thermopiles around the cold plate. Here also it was possible by using copper jumper wires to form a 5, 10, 15 or

Fig. 2 Fluid heat meter composed of two, 20-junction units surrounding plug heater inserted in the pipeline. The second or hot 20-junction unit was installed vertically to assure full flow within the pipe

The author — CHARLES N. HINKLE — is associate professor of agricultural engineering, South Dakota State College, Brookings.

*Hinkle, C. N., Effects of selected environmental factors on the absorption of radiation from a 100 F surface by cold plates. Unpublished Ph.D. dissertation, University of Missouri, August 1957.

An "Instrument News" contribution. INSTRUMENT NEWS (Karl H. Norris, editor) is sponsored by the ASAE Committee on Instrumentation and Controls. Articles on agricultural applications of instruments and controls and related problems are invited and should be submitted direct to K. H. Norris, 105A South Wing, Administration Bldg., Plant Industry Station, Beltsville, Md.

20-junction thermopile. The electrical leads from the plug heater were connected to the voltmeter, ammeter, and the voltage controller.

The need for electrical insulation of the thermocouple junctions in the fluid was checked by placing two uninsulated junctions of a 2-junction thermopile in hot tap water and noting the variance in emf registered on the potentiometer as the two junctions approached each other. The junctions were approximately ⅛-in. apart before any change in registered emf was noted. Several methods of complete insulation can be used, however, if desired. For butt-welded junctions insulating varnish was satisfactory. For hook joints or other joints with sharp edges, dipping in a liquid insulating plastic such as used for insulating tools used in electrical work was effective.

In use, the thermopile unit around the cold plate could be used to accurately determine the temperature difference across the cold plate. Likewise, by measuring the heat input to the plug heater and the temperature difference across it, the weight rate of flow could be determined by the Thomas meter principle without having to know anything about the fluid except its specific heat.

This fluid heat meter was better used, however, to directly measure the heat picked up by the cold plate. This was accomplished by cross-connecting the thermopile around the cold plate to the thermopile around the plug heater in such a fashion that the emf produced by each opposed the other. The desired reading on the potentiometer thus became zero millivolts and the voltage supplied to the heater was adjusted by the voltage controller until the zero reading was realized.

If 10 junctions from the plate were opposed by 10 junctions from the heat meter, then the heat picked up on the plate would be the watts indicated by the product of the voltmeter and ammeter. If 10 junctions from the plate were opposed by 20 junctions from the heat meter, the heat picked up by the plate would be greater than the product of voltmeter and ammeter by a factor of two. Similarly, multiplication factors of one-half, two, three, and four were possible.

. . . Artificial Shade Materials

(Continued from page 759)

Briefly, the advantages and disadvantages of some of the materials are as follows:

Hay. Hay was found to be one of the best materials for shades with respect to its thermal qualities. This can be attributed to its relatively high insulating value, low reflectance on the bottom surface, and good surface characteristics for losing absorbed heat by convection to the air, well above the animal's living zone. These characteristics more than offset the disadvantage that the upper surface of a hay shade is a very poor reflector of solar energy. It has structural disadvantages, such as poor protection from rain, possible harbor for pests, heavier dead load than some other materials, etc.

Aluminum. Aluminum, which is light weight and long lasting, is generally regarded as a good shade material. White paint on the upper surface was of little additional benefit, although painting the bottom black to reduce reflection from the ground improved conditions considerably. Age of the aluminum even up to ten years reduces efficiency surprisingly little.

Galvanized Steel. This material proved only slightly less effective than aluminum. Painting the upper surface white and the bottom black, or just painting the upper surface white, increased its effectiveness markedly. The effectiveness was only slightly reduced by the end of a year, the length of this particular test.

Films. Polyethylene plastic film of various colors and combinations was tested. Translucent film, regardless of thickness, was a poor shade material. Black film was slightly better. A laminated film, white on top and black on the bottom, ranked above the standard. A double layer of black film, spaced about 2 inches apart, was even better, illustrating the value of insulation even in a structure of this kind.

Woven green Saran shade cloth ranked below aluminum partly because of its color, partly because of the amount of sunlight passing through the weave openings. In some areas this openness is desired, because it allows the ground to dry out below. (The same can be said for snow fence.)

Neoprene films were effective when the upper surface was aluminum colored, but poor when left black.

All of the films and the snow fence have their place in the animal shelter and the shade field—they are light, economical, and easily erected, and they may be made portable.

In summary, these tests were conducted as a field experiment in order to measure the effectiveness of the various shade materials in their ultimate environment, the feed or dairy lot, and in relation to the animal being sheltered as far as was possible. As measured by laboratory instruments, differences in reflectance would have been much larger in some cases than indicated here, but when these values are included with other material characteristics in the complex heat-transfer relations involved, the net result is sometimes in favor of the low-reflectance materials.

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3 Ittner, N. R. and Kelly, C. F. Cattle shades. *Journal of Animal Science,* 10:184-194, 1951.

4 Bond, T. E. and Kelly, C. F. The globe thermometer in agricultural research. AGRICULTURAL ENGINEERING, 36:251-255, 1955.

Part II Tractor Book Available

"DEVELOPMENT of the Agricultural Tractor in the United States," Part II, by R. B. Gray is now available. This edition is a complement to Part I which included an account of the early history of the agricultural tractor with brief specifications of many of the tractors produced by manufacturers of the steam traction engine and the gas tractor and discussed mechanical farm power from its beginning to 1920. Part II covers the period of history on the development of both wheel and track-type tractors from 1920 to 1950.

The first edition of Part I was printed in 1954 by the Agricultural Engineering Research Branch, Agricultural Research Service, U.S. Department of Agriculture. Because of a demand for additional copies and its historic value, the American Society of Agricultural Engineers sponsored a second printing of Part I in 1956. In order to make both editions available, ASAE has sponsored the first publication of Part II.

Fig. 4 Productivity vs. Wages — Manufacturing Industries

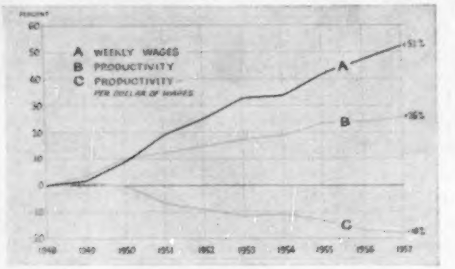
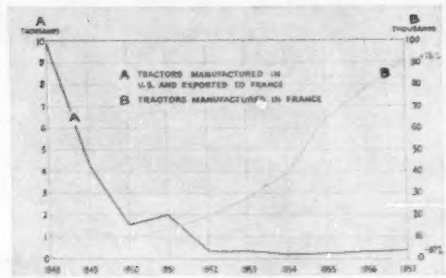


Fig. 5 Tractors in France — Units



. . . Challenge to Engineers

(Continued from page 749)

are on dangerous ground, as Figs. 3 and 4 will show. (The source of the figures used in these charts is the U.S. Department of Commerce and are of course only approximate; such things as GNP and productivity cannot be measured exactly.)

The increase in productivity over the last ten years is shown in Fig. 3, productivity being measured by the output in goods and services per man-hour of work paid for. Line *A* shows an increase in productivity of 49 percent for agricultural workers; line *B* a 26 percent increase for workers in manufacturing, and line *C* an average for all workers of 31 percent.

How was this increase in productivity accomplished? It certainly did not come from labor working harder. On the contrary, most organized labor seems determined to push productivity down instead of up. It could have come only from technological progress and the increased use of more and better machines and methods. The scientists and engineers responsible for the relatively great progress in the agricultural industry may indeed be proud of their accomplishments. This is particularly noteworthy considering the fact that this 49 percent increase in productivity is on top of the tremendous progress that was made over the preceding 30 years. It is hard to realize that the tractor which is commonplace today, started taking over from the horse in a big way only 40 years ago. In this brief 40-year "tractor age," agricultural productivity has probably increased more than in all the centuries since prehistoric man first scratched the ground with a stick.

We must of course give due credit to the farmers and manufacturers who were smart enough to make or employ these advanced products and methods. And we must also give them credit for having the good judgment to employ, either directly or indirectly, the men who could create these machines.

Now lets see what is happening in the manufacturing industries. Line *A* of Fig. 4 shows how workers' pay has risen 52 percent in the last 10 years. Line *B* is again the curve of productivity which has risen only 26 percent. This means that the productivity per dollar of wages has gone down 18 percent as shown by line *C*. Here is where we are in trouble. In fact, we are in double trouble, for the following two reasons:

1 This is one of the major causes of inflation. As long as wages go up faster than productivity, prices will automatically go up. Manufacturers cannot continuously absorb increased costs and stay in business.

Suppose, for example, that in a given year wages go up 5 percent and productivity only 2½ percent. Prices will then necessarily rise 2½ percent to cover the increased manufacturing costs. Labor's *net gain* is, therefore, only 2½ percent, equal to the increase in productivity, instead of 5 percent. The other 2½ percent of his wages are absorbed by the increased cost of living. We simply cannot have more than we produce.

Actually in trying to get more than it produces labor hurts itself, and everybody else, because the inflation it has caused has reduced the value of its savings and insurance. It is the same old story: the fellow who tries to get something for nothing gets stung.

Instead of picket lines demanding more wages, it would make more sense if labor picketed the universities, research centers, and engineering departments, demanding more technological progress. Fortunately there are signs that some of the more responsible labor leaders are recognizing the importance of these facts.

2 Our continually rising manufacturing costs, resulting from wages going up faster than productivity, are ruining industry's competitive position in world markets.

Fig. 5 shows a somewhat extreme example of what is happening. Our tractor exports to France (line *A*) have dropped from 10,000 machines in 1948 to only 300 machines in 1957. Meanwhile the sale of tractors in France has soared. Tractors manufactured in France (line *B*) has increased from 10,000 to 90,000 machines annually in the same period.

Tractor production in the United Kingdom, France and Germany has risen from a mere trickle after World War II until it is now about equal to, or greater than, that of the United States. We are no longer the great invincible industrial giant. Our total export of farm machinery to all the countries of Europe has dropped to about *one tenth* of what it was in 1948.

This great change has, of course, not been entirely due to our rising costs. Immediately after the war our government rushed in with loans and direct aid to rebuild the economies of Germany and our European allies. This combined with their own hard work, and determination born of necessity, put them on the upward road. Then most American manufacturers established plants or subsidiaries in Europe, lured by the growing market and lower manufacturing costs. Also, there were the factors of dollar shortages and government restrictions on imports. The fact remains, however, that most of our farm machinery is no longer competitive in European markets.

The same general pattern is being repeated in Latin American and other areas, except the timing is a little later.

Our exports of farm machinery to Latin America increased up to 1951, but then the competition from the strengthened European manufacturers began to be felt, and since 1951 our exports have been cut in half.

While the farm machinery industry may have been hurt more than most others, there are many storm warnings being raised in other waters, all the way from raw materials to the most advanced jet planes and nuclear reactors. A steel industry executive, speaking recently at a technical meeting of the American Iron and Steel Institute, warned "The steel industry one day will learn the hard way that it is not competitive with Russia's state-owned steel industry." Also recently, a top executive attending the second United Nations International Atomic Energy Conference lamented: "European companies will soon be selling the same atomic power plants we are trying to export at less than half our prices."

In addition to losing foreign markets all over the world, there is even some evidence that we are in danger of losing the competitive battle right here in the United States. Here are two straws in the wind: (1) at least two major American farm machinery manufacturers are now importing tractors from Europe, and (2) sales of foreign cars in the United States have tripled in the last two years.

Our economists tell us that we are about to enter a new era of prosperity in the "fabulous sixties," exceeding anything we have known before. The explosion in the number of new families in the United States will require a major expansion of our economy. In addition, the economic growth and consequent raising of the standard of living of all the countries of the world should open vast new markets for our products. All of this will probably come true *if* we can control inflation and *if* we can be competitive. If we can *not* do this, we may be faced with the collapse of our economy, and our population growth will only add to the rolls of the unemployed.

We as engineers can do something about this problem. We must design and develop machines that are lower in cost and more productive. A machine that costs too much is just as much an engineering failure as one that fails to do a job for any other reason. As every good engineer knows, there is not a single machine on the market that cannot be made cheaper and better with a little ingenuity. In addition, we are ripe for some major breakthroughs to entirely new methods and machines. This will take some real creative thinking. This is what we *must* do to recover our competitive position and to hold the line against inflation.

. . . Farm Drainage

(Continued from page 757)

where one plant drains several thousand acres or more, enough power can efficiently be used each month to reduce the rate per kilowatt-hour by 50 percent. From this standpoint it would be more economical for a number of farmers to work together and install one larger pumping plant than for each to have his own.

Farm pump drainage in Michigan is expected to increase quite rapidly in quantity and quality in future years for the following reasons:

1 Productive lands in the south half of Michigan which are easily drained are already developed. Further development of existing cropland or future development of additional cropland, in many cases, will involve pump drainage.

2 Productive lands in Northern Michigan which are to be developed will in many cases require pumping to provide adequate drainage. One of the main reasons will be the lack of over-all development within a watershed to provide the needed cooperation of a large enough group of landowners to establish an adequate gravity outlet.

3 More efficient operations are demanded of today's farmers to meet the present economic and mechanization trends. Better drainage by pumping is sometimes the answer.

4 Many existing pumping plants need to be redesigned for present conditions and more efficient operation.

5 The trend to suburban living has increased the problems of maintaining ditches deep enough to provide proper outlet for tile systems. Land owners are objecting to deep ditches along roads and across their property unless they are directly affected by poor surface drainage. Even then a ditch deep enough and with proper side slopes to provide an outlet for tile systems may be larger than is necessary for proper surface drainage.

References

1 Corps of engineers monthly report on lake levels for May, 1957, Detroit, Michigan, June 3, 1957.

2 Shafer, Fred. The problems of controlled drainage for muck and peat lands, Soil Conservation Service, USDA, July, 1946.

Recent Developments in Hay Crushing, by William Kjelgaard, agricultural engineering department, Pennsylvania State University, University Park. Presented at the North Atlantic Section Meeting at Guelph, Ontario, Canada, August 1958. **Paper No. 58-323.**

The author considers ways to accelerate the process of field curing in hay making and discusses the effects of weather and mechanical processes such as crushing and crimping. The manuscript is in the form of a progress report of work done in connection with the NE-13 Research Project dealing with mechanization of forage crop harvesting, processing, storing, and feeding.

The Future of Hydraulics in Agriculture, by P. H. Southwell, assistant professor of agricultural engineering, department of engineering science, Ontario Agricultural College, Guelph, Ontario, Canada. Presented at the Annual Meeting of the North Atlantic Section, Guelph, Ontario, Canada, August 1958. **Paper No. 58-325.**

The subject discussed in this paper is introduced with a brief history of hydraulic power as applied to agricultural equipment. The author believes that the great future for hydraulics in agriculture lies in the use of hydraulic motors to produce rotary motion, as compared with its present use in the production of linear motion. He also presents the use of hydrostatic transmissions as having interesting possibilities.

Evolution of the Wheeled Farm Tractor, by Martin Ronning, chief engineer, product research, Minneapolis-Moline Co., Minneapolis, Minn. Paper presented at the North Atlantic Section Meeting, Guelph, Ontario, Canada, August 1958. **Paper No. 58-326.**

This paper traces the early history and progress of the wheeled farm tractor outlining the introduction of the three-point hitch, power take-off, and other developments. The author mentions some further improvements in tractor design which he feels would add to the usefulness and convenience of farm tractors.

EJC Incorporated

EJC has become Engineers Joint Council, Incorporated, by action of the board of directors on July 10. The newly-elected officers include: E. R. Needles, president; O. B. J. Fraser, vice-president; E. L. Chandler, treasurer; E. P. Lange, secretary; and L. K. Wheelock, assistant secretary.

President Needles states that he believes the change of the council to a corporate status is a definite step toward unity in the engineering profession. With the election of the American Institute of Plant Engineers as an associate member to be effective immediately the number of members in Engineers Joint Council has reached 19.

Research Seminar

A seminar on the "Approach to a Research Problem" will be conducted during the Winter Meeting of ASAE in Chicago by the Committee on Research of the Education and Research Division. The session is open to all and is scheduled for 7:00 p.m., Wednesday, December 17, in the Wabash Parlor, 3rd Floor, the Palmer House. Hay pelleting has been selected as the example problem.

Dr. K. E. Gardner, dairy science department, University of Illinois, will open the discussion by indicating the importance and complexity of the problem and the need for an analytic approach to its solution by both public service and industry.

A panel, composed of members of the Committee on Research and representing the various functions of research, will present short comments on Dr. Gardner's discussion, after which the session shall be open for questions from the floor.

Two moderators—one from public service and one from industry—shall accept the questions and direct them to the proper panel members for answer. Barton C. Reynolds, Office of State Experiment Stations, will represent public service and K. W. Anderson, manager of product research, Deere & Co., will represent industry.

Short Course Proceedings

Proceedings are now available for two short courses conducted during the past summer dealing with Materials Engineering Design for High Temperatures and Mechanical Properties of Materials. Copies may be obtained by writing to J. Marin, Department of Engineering Mechanics, The Pennsylvania State University, University Park, Pennsylvania.

ECPD Approves Colorado State AE Program

Norman A. Evans, head, agricultural engineering department, Colorado State University, Fort Collins, has announced that the department has been recently accredited by Engineers' Council for Professional Development.

FEI Elects Officers

George A. Kelly II, president, G. A. Kelly Plow Co., was elected president and Curt L. Oheim, vice-president, Deere & Co., (member of ASAE) was named chairman of the executive committee of the Farm Equipment Institute during its 65th annual convention held October 1.

ASAE members elected to the executive committee include Merritt D. Hill, general manager, Tractor & Implement Division, Ford Motor Co.; James H. Willson, president, Athens Plow Co.; George C. Delp, president, New Holland Machine Company, and C. C. Mullen, president, Rome Plow Co. Others elected to the executive committee were Frank W. Jenks, president, International Harvester Co., John T. Phillips, Sr., president, Lilliston Implement Co., and J. H. Thomsen, executive vice-president, Dempster Mill Mfg. Co.

AAAS Engineering Meeting

Section M — Engineering Portion — The 125th Annual Meeting of the American Association for the Advancement of Science will meet December 26-30 at the Hotel Statler, Washington, D.C. A series of outstanding general addresses will be given by authorities in their field. The general sessions which consist of reports of research trends and findings have been entitled "Moving Frontiers of Science." The third consecutive program on this theme will be given this year on comparative patterns of scientific organization. National and international aspects of engineering systems of units will be discussed December 29 and 30. The American Society of Photogrammetry will meet for two sessions on December 29 and the Instrument Society of America will meet on December 30. Also ten leaders in engineering and science will appraise the needs for engineers and scientists for 1959.

FEI Winter Meeting

The Winter Meeting of the Farm Equipment Institute, sponsored by FEI Production and Marketing Department, will meet January 16, 1959, at the Hershey Hotel, Hershey, Pennsylvania. Highlights of the meeting will include a discussion on methods of production and the use, distribution and quality of farm machinery in Russia, by ASAE member Karl Butler, agricultural consultant, Avco Mfg. Co.; a presentation on sales implications of public relations, by Kenneth W. Haagensen, Allis-Chalmers Mfg. Co.; a discussion on machinery aspects of hay pelletizing, by ASAE member H. D. Bruhn, University of Wisconsin, and a panel which will review the industry outlook.

EVENTS CALENDAR

December 17-18 — *1958 Beltwide Cotton Production Conference,* Rice Hotel, Houston, Tex. Contact E. E. Robinson, National Cotton Council of America, P.O. Box 9905, Memphis 12, Tenn.

December 29-30 — Section M—Engineering portion of Annual Meeting of the *American Association for the Advancement of Science,* Hotel Statler, Washington, D.C. Program available after October 15 from Secretary, Section M, c/o E. J. C., 29 West 39th St., New York 18, N. Y.

January 16 — Winter meeting of *Farm Equipment Institute* by FEI Production and Marketing Dept., Hershey Hotel, Hershey, Pa.

January 26-27 — *First Annual ASLE Gear Symposium,* Morrison Hotel, Chicago, Ill. For further information write to American Society of Lubrication Engineers, 84 E. Randolph St., Chicago 1, Ill.

February 2-4 — 1959 Meeting of the *Association of Southern Agricultural Workers,* Memphis, Tenn., at the Peabody Hotel. Contact C. E. Kimmerly, Jr., secretary-treasurer ASAW, Agricultural Extension Service, Louisiana State University, Baton Rouge, La., for details.

February 4-6 — *New England Rural Electrification Institute,* Durham, N. H. For additional information write John J. Kolega, Agricultural Engineering Department, University of New Hampshire, Durham, N. H.

February 4-6—*Home Improvement Products Show* at the Coliseum, New York, N. Y. For further details write Ted Black, Public Relations, Medical Art Bldg., Reading, Pa.

February 8-14 — Observance of *National Electrical Week.* For additional information write to R. J. Gingles, 290 Madison Ave., New York 17, N. Y.

February 26-27 — *7th Annual National Dairy Engineering Conference,* Kellogg Center, Michigan State University, East Lansing, Mich. For information write Carl W. Hall, Agricultural Engineering Dept., Michigan State University, East Lansing, Mich.

March 3-8 — *30th Salon International de la Machine Agricole,* Exhibition Ground of Porte de Versailles, Paris, France. For entry card and further information write Salon International de la Machine Agricole, 95, Rue Saint-Lazare, Paris-9e, France.

April 5-10—*1959 Nuclear Congress,* Public Auditorium, Cleveland, Ohio, sponsored by Engineers Joint Council, 29 West 39th St., New York, N. Y.

April 5-16 — *First International Farmers Convention in Israel.* Write to Allied Travel Inc., 103 Park Ave., New York 17, N. Y.

May 5-7 — *14th Purdue Industrial Waste Conference,* Purdue University. For details write Don E. Bloodgood, Purdue University, School of Civil Engineering, Lafayette, Ind.

May 7-9 — *First World Congress for Agronomic Research,* Headquarters of the FAO, Rome, Italy. Organized by the International Confederation of Agricultural Engineers and Technicians. For details contact The CITA Secretary's office, (1st World Congress of Agricultural Research), Beethovenstrasse 24, Zurich, Switzerland.

May 18-20 — *Fifth Annual Symposium on Instrumental Methods of Analysis,* Shamrock-Hilton Hotel, Houston, Texas. Apply to Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

Virginia Section

Eighty-five members and guests were registered at the Virginia State Section Meeting held October 10-11, on the Virginia Polytechnic Institute campus. Papers presented at the first session on Friday morning included topics on water conservation and use problems in East Pakistan, tilt-up farm construction, and Case-O-Matic transmission. Ralph Palmer, assistant secretary and treasurer of ASAE, gave a report from ASAE headquarters. A VPI Student Branch activities report was given by H. M. Wilson, president.

Presentations during the second session considered relative costs of residential heating and included a panel discussion on the subject.

The speaker for the evening banquet was Reverend Raymond E. Cardwell, pastor of the Blacksburg Methodist Church.

During the business session, held Saturday morning, two resolutions concerning professional registration of engineers were approved and passed on to the ASAE headquarters for further action. The meeting concluded with the installation of the following officers: chairman, J. M. Stanley, ARS, USDA, Virginia Polytechnic Institute; vice-chairman, J. G. Moses, Soil Conservation Service, Rocky Mount; vice-chairman, E. S. Smith, Virginia Polytechnic Institute; vice-chairman, J. E. Collins, Appalachian Electric Power Co., Roanoke; secretary-treasurer, J. P. H. Mason, Jr., Virginia Polytechnic Institute.

Shown is a portion of the 108 registrants who attended the first regular meeting of the Central Illinois Section held in Peoria, October 16. *(Left to Right)* David Johnson, student, University of Illinois; Millard Monroe, Atwood; John Chapman, student, University of Illinois; A. R. Ayres, section vice-chairman, and F. L. Herum, section secretary-treasurer

Central Illinois Section

The first regular meeting of the Central Illinois Section was held at Bishop's Cafeteria, Peoria, Illinois, on October 16, 1958, with 108 members, student members and guests present.

Dr. F. B. Lanham, head, department of agricultural engineering, University of Illinois, announced increases in both undergraduate and graduate enrollment in agricultural engineering at the university and told of progress made in gaining approval for the university's Ph.D. program in agricultural engineering.

The main speaker was E. J. Stirniman, special representative, Caterpillar Tractor Co., who gave an illustrated talk on problems encountered in his agricultural engineering work, primarily in tillage and crop handling, throughout the world.

Pennsylvania Section

The Pennsylvania Section held its regular fall meeting on October 16-17 at the Abraham Lincoln Hotel in Reading. The theme of the meeting was "Materials Handling as Related to: Power and Machinery, Rural Electrification, Soil and Water Conservation, and Farm Structures." A. J. Swearingen gave a paper on materials handling fundamentals, A. M. Best reported on what's ahead in pelleting, Rodney Martin discussed modern dairy housing units and inherent handling problems, and the subject of rural water use in the Delaware Basin in handling earth in construction of diversions was presented by two SCS engineers, Gail Eley and D. T. Dinsmore. The subjects of what's ahead in poultry housing and a package poultry house for the industry, were presented by D. C. Sprague and Fred Calkins. The Friday afternoon program included a field trip to the Morgantown iron mine of the Bethlehem Steel Corp.

Officers elected for the coming year are: chairman, J. A. McCurdy; vice-chairman, M. J. Happe; secretary-treasurer, M. D. Shaw, and the nominations committee, composed of three members, include A. S. Mowery, H. W. Miller and L. D. Kimmel.

Georgia Section

The fall meeting of the Georgia Section was held October 24 at the University of Georgia in Athens. Sessions were held in the new University of Georgia Center for Continuing Education with 64 members and guests in attendance. An excellent program was presented around the theme, "Agricultural Engineering in Georgia's Changing Economy."

The morning sessions included talks by Louis Griffeth, assistant to the president, University of Georgia, and George King, director of agricultural experimental stations. Other speakers were J. W. Harwell, C. M. Wallace, Jr., J. N. Bayley and J. Dewey Long, who represented the fields of soil conservation, farm electrification, power and machinery, and farm structures, respectively. *(Continued on page 770)*

(Above) **J. N. Bayley, president of Atlanta Farm Equipment Club, addressed the Georgia Section of ASAE during its fall meeting October 24 at the University of Georgia, Athens**

(Right) **Past Chairman Oscar Lange, left, and newly-elected Chairman J. A. McCurdy discuss affairs of the Pennsylvania Section between sessions at a recent Section meeting in Reading**

L. H. Hodges

R. R. Roth

H. H. Beaty

T. Goldoftas

Lawrence H. Hodges, former chief product engineer for the Rockford Works, J. I. Case Co. has been advanced to assistant works manager. Before joining the J. I. Case Co. he spent six years as assistant professor of agricultural engineering at the University of Wisconsin. He holds a B.S. degree in agricultural engineering from Texas A & M College as well as a B.S. degree in mechanical engineering from the University of Wisconsin.

He spent over three years during World War II in the U.S. Army Artillery, serving in the European theater. He holds the rank of major in the Reserve and is presently serving as director of Artillery School in the USAR School Program in Rockford, Ill.

In 1952 he joined the engineering department of the Rockford Works, J. I. Case Co., as design engineer, receiving successive promotions of assistant-to-chief engineer, chief product engineer, and his present assignment, assistant works manager.

He has been an ASAE member since 1943 and is presently chairman of the Technical Committee, Power and Machinery Division.

Robert R. Roth has been promoted from product engineer in charge of harvesting division, to assistant chief product engineer, Rockford Works, J. I. Case Co. Prior to joining the J. I. Case Co. earlier this year he was project engineer in charge of tillage implements with the Minneapolis-Moline Co. He obtained his formal education from the University of Missouri where he received B.S. degrees in agricultural engineering in 1943 and mechanical engineering in 1947. He served as instructor in agricultural engineering at the University of Missouri for one year. He has been a member of ASAE since 1943.

Harold H. Beaty has returned to the teaching field after seven years as rural service manager with the Edison Electric Institute by accepting a position as professor of agricultural engineering at the University of Illinois. He comes to his new post with broad experience in rural electrification. Prior to his affiliation with Edison Electric Institute he was in charge of electrification programs at Iowa State College since 1936 where he directed extension, research and teaching activities in rural electrification. He is also experienced in electric light and power company operation in that he was associated with the Iowa Electric Company, Cedar Rapids, prior to his appointment to Iowa State College. He has been a member of ASAE since 1937. He obtained a B.S. degree in electrical engineering and an M.S. degree in agricultural engineering from Iowa State College in 1931 and 1942 respectively.

Tobi Goldoftas, formerly employed as design engineer, Farm Tractor Division, International Harvester Co., has accepted a position as senior project engineer, Crawler Tractor Division, J. I. Case Co., Fort Wayne, Ind. Tobi served as vice-chairman of the Chicago Section of ASAE in 1957 and was serving as secretary-treasurer until his move to Fort Wayne.

D. Cromer Heitshu, for many years chief engineer, John Deere Harvester Works, Moline, Ill., has announced his retirement to satisfy a longtime ambition to operate a 160-acre fruit orchard in Shippensburg, Pa. He reports that he plans to do some consulting work until the young orchard can earn its way. His new address is Sand Bank Orchard, Route 3, Shippensburg, Pa.

R. J. Warren who has been with LeTourneau-Westinghouse in Peoria, Ill., is now employed by the Clark Equipment Co. as field engineer, Construction Division, in Benton Harbor, Mich.

Kenneth L. McFate, assistant professor, agricultural engineering department, University of Missouri, has been named as winner of a $100.00 United States Savings Bond for submitting the best entry in a contest to name the annual meeting held under the sponsorship of the Inter-Industry Farm Electric Utilization Council. Mr. McFate said that the name he submitted, "National Electric Farm Power Conference" was suggested because he believes it correctly signifies the true reason for the formulation of IIFEUC, it is descriptive of the type of meeting to be held, and it provides a significant "tie-in" with the Electric Power and Processing Division of ASAE "whose standards, recommendations, codes and data do much towards more and proper use of electricity on the farm."

Wilbur P. Ball has been appointed to the teaching staff at Fresno State College, Fresno, Calif. His new assignment makes him head of the teacher education program in the agricultural division.

Dr. Ball received both BSA and MEd degrees at Colorado State University in 1948 and 1952 respectively. He completed a Ph.D. degree in agricultural education with minors in agricultural engineering and rural sociology at Iowa State College in 1956.

Following graduation from college in 1948, he served as a vocational agriculture teacher in the Logan County Branch High School, Fleming, Colo., for two years. From 1950 to 1953 he became a supervising teacher of vocational agriculture in the Berthoud Public Schools. During the years 1953 to 1956 he was a member of the farm mechanics teaching staff in the agricultural engineering department at Iowa State College. For the past two years he served as an agricultural education consultant under the ICA-Stanford University Contract at the Central Luzon Agricultural College, Nueva Ecija, Philippines.
Pacific.

J. G. Hartsock has transferred to the Farm Electrification Research staff of AERD, USDA, at Lafayette, Ind. He will be in charge of ARS studies in cooperation with the Purdue Agricultural Experiment Station on the use of light traps to locate infestations for the control of cereal and vegetable crop insects. He also will work on mechanization of caged laying hen systems.

Mr. Hartsock formerly was stationed at the Minnesota Agricultural Experiment Station, where he studied means of labor reduction in dairying through the use of electricity.

W. A. Junnila, of Agricultural Engineering Research Division Farm Electrification Research staff, USDA, formerly stationed at the Connecticut Agricultural Experiment Station, is now serving at the Minnesota Agricultural Experiment Station, replacing **J. G. Hartsock,** who has transferred to the staff at Lafayette, Ind. At Connecticut Mr. Junnila worked primarily on studies of poultry house lighting and related subjects.

NECROLOGY

L. G. Heimpel, former professor and head of the agricultural engineering department at Macdonald College, Quebec, Canada, and Life Member of ASAE, died at his home September 2, 1958. Mr. Heimpel was born in Petersburg, Ontario, December 4, 1890. He graduated from the Ontario Agricultural College in 1918 and received an M.S. degree from Cornell University in 1931.

L. G. Heimpel

Mr. Heimpel had a distinguished career as a teacher and experimenter in improving farming methods. As engineering consultant to the *Family Herald* he was well known across rural Canada for his ideas and designs of equipment for easier living on the farm.

In 1920 he began his teaching career at the Agricultural School at Kemptville, Ontario. The following year he moved to Macdonald College as head of the agricultural engineering department.

Following World War II he was called upon to direct a Rural Repairs Shop course at the college for veterans. He retired as chairman of the agricultural engineering department in 1952 and spent the last six years in Whitby, Ontario. His membership in ASAE dated back to 1921.

. . . With ASAE Sections

(Continued from page 768)

The afternoon session was devoted to timely reports on research findings by Harold White on poultry processing; A. T. Hendrix on bunker silos; J. I. Davis on land clearing; R. H. Brown on milk flowmeters; R. L. Givens on cattle shades and shelters; J. T. McAlister on mulch tillage, and A. P. Barnett on a rainfall simulator.

A social hour and banquet were held following the meeting with Wally Butts, Georgia football coach, as speaker.

South Carolina Section

The first Annual Meeting of the South Carolina Section was held at Clemson College October 30-31. The program began with T. V. Wilson, agricultural engineer, Clemson College, discussing the availability of underground water for irrigation in South Carolina. This was followed by an explanation of the principles of operation and operating characteristics of the new free-piston engine being developed by the Ford Motor Co. The afternoon program was concluded with a report of late developments in feed processing and handling by R. C. Carroll and H. P. Lynn, extension agricultural engineers, Clemson College. The meeting was high lighted by the banquet held on the evening of October 30 at the Clemson House which featured R. C. Edwards, acting-president of Clemson College, as speaker. Mr. Edwards spoke on the changing agriculture in South Carolina and the place of agricultural engineers in the future progress of our country.

The October 31 program included an interesting presentation on agricultural engineering — its potential in Asia, by G. H. Dunkleberg, agricultural engineer, Clemson College; a discussion of land leveling for furrow irrigation and surface drainage, by R. Molinaroli of the Soil Conservation Service; and a paper by E. B. Rogers on pelleting coastal Bermuda grass. The group made an inspection tour of the Lee Stream Generating Plant in Williamston during the afternoon.

New officers for the section include: M. T. Geddings, chairman; W. N. McAdams, J. H. Anderson and W. A. Jones, vice-chairmen; and T. V. Wilson, secretary-treasurer.

Connecticut Valley Section

New officers for the Connecticut Valley Section are as follows: chairman, J. T. Clayton, University of Massachusetts; senior vice-chairman, Frank Smith, Portland Cement Association; junior vice-chairman, Clifford Mellor, Eastern States Farmers Exchange, and secretary-treasurer, R. P. Prince, University of Connecticut.

Counselors elected to the Engineering Society of New England include M. S. Loring, Portland Cement Association and J. J. Kolega, University of New Hampshire.

North Atlantic Section

A new attendance record was set for the North Atlantic Section at the Annual Meeting held at Ontario Agricultural College in Guelph on August 25-27. The total number in attendance was 496, with the greatest number coming from Ontario, Pennsylvania, New York, Massachusetts and Maryland, in respective order.

An outstanding level of local arrangements for accommodations, entertainment, tours, and general handling of this large group was also set by Professor and Mrs. Downing and their local arrangements committee. This, together with the program planned by Section Chairman Peikert and his committee, resulted in an excellent meeting.

A first place Student Paper Award was won by L. M. Greiner, University of Connecticut, and second place award was received by J. R. Hammerle of Pennsylvania State University. The winning papers were chosen from among 14 manuscripts received from five institutions.

Officers elected for 1958-59 are: F. L. Rimbach, chairman; C. N. Turner, vice-chairman, and R. W. Kleis, secretary-treasurer.

The 1959 meeting of the North Atlantic Section is to be at the University of Maryland under the local arrangements chairmanship of R. L. Green. Program committeemen for that meeting are: F. H. Theakston, Farm Structures; W. B. Schumacher, Power and Machinery; L. H. Hammond, Electric Power and Processing, and Joseph Bornstein, Soil and Water.

Preliminary planning for the 1959 meeting was done at a meeting of the Executive and Program committees at the Harvard Club in New York on November 24.

James Hammerle, *(Center)* Pennsylvania State University student and second place student paper award winner, discusses his award winning paper with Frank Piekert, chairman of North Atlantic Section of ASAE *(Left)* and Robert S. Palmer, chairman of Student Paper Award Committee, during recent North Atlantic Section Meeting held in Guelph, Ontario. L. M. Greiner, University of Connecticut, and first place winner, is not shown

ASAE MEETINGS CALENDAR

December 17-19 — WINTER MEETING, Palmer House, Chicago, Ill.

January 9 — QUAD CITY SECTION, place to be announced.

January 15 — MINNESOTA SECTION, Lilac Lanes Cafe, intersection of Excelsior Blvd. and Highway 100, Minneapolis, Minn.

February 2-4 — SOUTHEAST SECTION, King Cotton Hotel, Memphis, Tenn.

February 4-5 — PACIFIC COAST SECTION, Asilomar Pacific Grove, Calif.

March 12-13 — SOUTHWEST SECTION, Dallas, Texas.

February 13 — MICHIGAN SECTION, Massey-Ferguson, Inc., 12601 Southfield Rd., Detroit, Mich.

April 3-4 — MID-CENTRAL SECTION, Hotel Robidoux, St. Joseph, Mo.

April 16-18 — FLORIDA SECTION, George Washington Hotel, West Palm Beach, Fla.

JUNE 21-24 — 52ND ANNUAL MEETING, Cornell University, Ithaca, N. Y.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

Quad City Section

The Quad City Section met November 14 at the American Legion Hall in Moline, Ill., with an attendance of 185.

The first speaker, R. C. Ready of the Contracting Division of Dravo Corp., Pittsburgh, Pa., described cofferdams and their uses and discussed problems encountered in the construction work on the second span of the Bettendorf-Moline Bridge. C. L. Callum, research engineer, John Deere Ottumwa Works, followed by relating his personal views regarding trends in the design of forage harvesting machinery.

The next meeting of the Quad City Section is scheduled for Friday, January 9, 1959.

Washington, D. C. Section

The Washington, D. C. Section met December 12, 1958, at South Building, USDA.

The speakers were chosen from the men who accompanied the Agricultural Engineering Exchange Group from USSR. W. M. Bruce and D. T. Black accompanied the group during August who were interested in mechanization and N. C. Teter accompanied the Structures team during September 11 to October 11. These men contributed to the interest of the meeting by presenting the latest agricultural news from both the home front and abroad.

Minnesota Section

The next meeting of the Minnesota Section will be in the form of a dinner meeting, to be held at 6:30 p.m., January 15, at the Lilac Lanes Cafe, located at the intersection of Excelsior Blvd. and Highway 100 in Minneapolis.

Major R. R. Cacchiotti of the U.S. Army Engineers will give a movie-illustrated discussion on the Army Missile Program. John Strait will follow with a presentation on hay conditioning and a report on the developments in wafered and pelleted hay.

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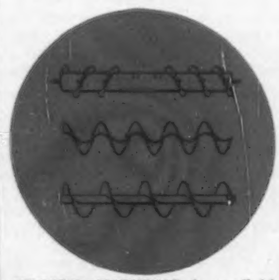

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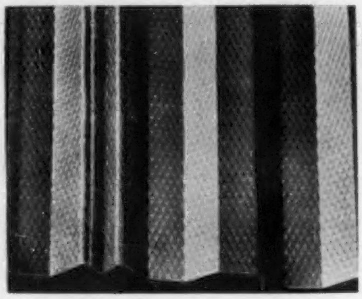
(For more facts circle No. 55 on reply card)

Aluminum Roofing and Siding

Kaiser Aluminum & Chemical Sales, Inc., announces "Diamond-Rib" roofing and siding, a new aluminum building material. The sheet is embossed with a glare diffusing diamond pattern and has "flat top" rib configurations to improve appearance and is said to give greater strength. A non-si-

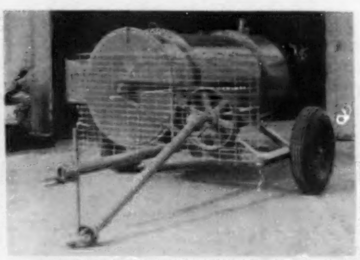


phoning feature prevents moisture from penetrating side laps after the sheet is installed on a structure. The manufacturer reports that the rib configurations in combination with diamond embossing give the sheet up to 30 percent greater load-bearing strength than heavier gauge 0.024-in. conventional corrugated or V-crimp aluminum roofing, although it costs less than either.

(For more facts circle No. 93 on reply card)

Portable Heat Blower

Behlen Manufacturing Co. is now producing a portable heat blower suitable for drying ear corn, small grains and hay, and other uses. The unit is available on a chassis with wheels or on runner assembly, and is equipped to burn propane or can be had with a unit to burn natural gas. It includes the direct burner which develops 4,000,000 Btu or more per hour. All models are equipped with automatic operat-

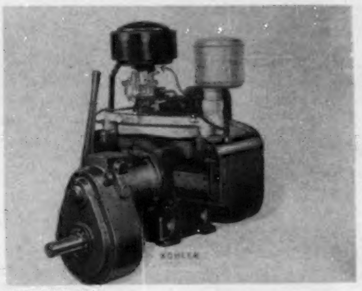


ing control system including automatic moisture control, air vane control, and high temperature control. The portable chassis includes wheels and 8-ply tires and has a 20-groove poly-vee belt, sheaves, tongue, safety guard, PTO shaft, and metal cabinet enclosing control system. The fan is the Behlen-developed axial vane with variable pitch.

(For more facts circle No. 94 on reply card)

New Heavy-Duty Engine

Kohler Company announces a new series of heavy-duty engines (Model K660CR)—an air-cooled, short-stroke, 4-cycle engine rated 24 hp at 3200 rpm, specifically designed for applications requiring heavy starting loads and low PTO speeds. The

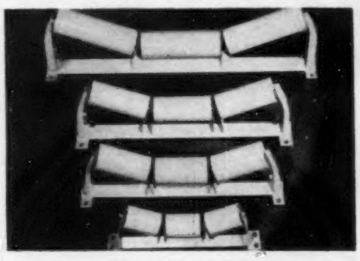


clutch-reduction assembly combines a dry-type clutch equipped with anti-friction ball bearings and a chain-drive reduction gear. The PTO shaft is mounted on roller bearings. Starting equipment consists of either a crank starter or a 6 or 12-volt starter-generator.

(For more facts circle No. 95 on reply card)

Belt-Conveyor Idlers

Link-Belt Co., Prudential Plaza, Chicago 1, Ill., has introduced a new line of belt conveyor idlers, in five series and in widths ranging from 14 to 84 in., increasing the number of idler variations the company manufactures from 38 to 64. All five of the



new idler series feature inverted angle bases. On all idlers, removable steel retainer clips at each bracket hold the rolls in position. All idlers are filled with grease at the factory and can be installed without further lubrication.

(For more facts circle No. 96 on reply card)

Farm Loader

New Idea Farm Equipment Co. announces a new farm loader available with hydraulic or mechanical bucket control. The

loader's accessories include dozer blade, 80-in. wide scoop, dirt bucket, and dirt plate for manure bucket.

(For more facts circle No. 97 on reply card)

Combination Crawler-Loader-Dozer

J. I. Case Co., Racine, Wis., announces a combination 42-hp crawler-loader-dozer. The combination loader and dozer has a ⅝-yd capacity especially designed for digging, loading, leveling, etc. The tractor is said

to develop 30 drawbar horsepower and 5690 lbs. drawbar pull or push. Optional rear-end attachments, including backhoe, scarifier, 5-ton winch, or 3-point quick-hitch for a large assortment of specialized tools add to the unit's versatility.

(For more facts circle No. 98 on reply card)

Selector Plug for Spraying Systems

Spraying Systems Co. announces a new rubber selector plug for use with its DDOC DocJet tips used for broadcast spraying. With this new selector plug, the tips can be set for left-hand or right-hand spraying. The plug is made of molded rubber and de-

signed with index tabs for easy and accurate positioning. The plug fits in the inlet side of the tip and acts as a control gasket. Either side of the tip nozzle may be blanked off as controlled by the placement of the plug. Besides being inexpensive, the new plug is said to be foolproof and leakproof.

(For more facts circle No. 99 on reply card)

Retractable Tractor Lugs

Eversman Mfg. Co., Denver, Colo., has added to its line the Re-Trak-Lug, an attachment designed to increase the traction of wheel tractors. The manufacturer reports that any of the popular makes of tractors

can be equipped with this lug simply by attaching it to the wheel rims with the rim lug bolts. No conversion is necessary and there are no holes to drill. Sizes are available for nearly all sizes of tractor rims, 24 in. and larger.

(For more facts circle No. 100 on reply card)

English for Engineers, by S. A. Harbarger, Anne B. Whitmer, and Robert Price. Fourth edition. Cloth, 5½ x 7¼, xii+226 pages. Published by McGraw Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. $3.75.

This edition is intended peculiarly for students with well developed interests in specialized technical fields. The aim of the book is to raise the professional sights of the student and "to lay the basis for subsequent and more definitely specialized intellectual endeavor." Chapters two to eight survey specific skills, emphasizing those basic to the student's professional writing. Chapters nine to nineteen deal with communications, reports, publishable forms, etc. They discuss background of expression, the minimum of accuracy, effective sentences, words, correct appearance, thought patterns, the "you" attitude, the letter of application, the sales letter, the order letter, the letter of inquiry, expedited forms of business communication, instructions, dictation, the abstract, the engineering report, technical publication, the professional society paper. The concluding chapter considers the widening of the engineer's cultural fields beyond the immediate utilitarian needs of his technical studies, particularly with reference to his professional library.

Process Engineering in the Food Industry, by R. J. Clarke. Cloth, 5½ x 8½ inches, vii+355 pages. Published by Philosophical Library Inc., 15 East 40th St., New York, N. Y. $10.00.

This has been written for those who are responsible for plant management and for improving its performance. Chemists and engineers entering the food industries will find it a comprehensive treatment of the operations with which they will have to deal. Subjects covered are fluid flow, heat exchange, filtration, evaporation, distillation, extraction, expression, crystallization, drying, dehydration, absorption, mixing, size reduction, gas absorption, and heat processing methods.

Crop Production in the South, by Glen C. Klingman. Cloth, 5½ x 8½ inches, viii +416 pages. Illustrated and indexed. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $4.95.

A text book dealing with the growth, breeding, and germination of plants, weed control, and forages. Nine chapters of the publication consider separately cotton, corn, tobacco, grains, peanuts, soybeans and cowpeas, sorghums, irish potatoes, and sweet potatoes.

Radioisotopes, A New Tool for Industry, by Sidney Jefferson. 5 x 7½ inches, 110 pages. Published by Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. $4.75.

In this book the author examines and explains the applications of radioisotopes for industry and their advantages. It includes an explanation of the elementary fundamentals of radioactivity, covering atomic structure, atomic energy and atomic piles, transmission and detection of the radiations and the health precautions essential to those working in this field.

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5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
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5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98
9	19	29	39	49	59	69	79	89	99
10	20	30	40	50	60	70	80	90	100

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PERSONNEL SERVICE BULLETIN

NOTE: In this bulletin, the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listing.

POSITIONS OPEN — JUNE — O-189-823, 199-825, 200-826. JULY—O-256-827. AUGUST—O-276-830. SEPTEMBER—O-308-831. OCTOBER — O-321-832. NOVEMBER — O-327-833, 330-834, 331-835, 340-836, 343-837, 344-838.

POSITIONS WANTED—JUNE—W-175-26, 188-27, 79-28, 192-29, 172-30, 205-31. JULY—W-197-32, 246-33, 251-35. AUGUST—W-258-38, 236-39, 260-40, 261-41, 242-42, 271-43, 286-44, 285-45, 287-46. SEPTEMBER—W-279-47, 297-48, 248-50. OCTOBER — W-314-52, 315-53, 322-54. NOVEMBER — W-332-55, 324-56, 325-57, 335-58, 339-59, 318-60.

NEW POSITIONS OPEN

AGRICULTURAL ENGINEER (graduate research assistant) for research and work toward MS degree in agricultural engineering in an eastern land grant university. Candidate may choose work in power and machinery, processing, farm structures, or materials handling. BSAE or equivalent, with academic average 2.80 or over for junior and senior years. Interest in research. Desire to earn MS degree. Available February 1 or July 1. Salary $3024 and tuition, eleven months duty, one month vacation. O-352-839

AGRICULTURAL ENGINEER for product design and general engineering in small livestock equipment manufacture involving mostly sheet metal items. Midwest location. No age limits. Must be fully acquainted with metal working machinery and livestock equipment. Advancement according to ability. Salary open. O-353-840

AGRICULTURAL ENGINEER for assistant chief engineer in the combine division of an established broad line manufacturer, to supervise design of harvester combines. Age open. Extensive experience in harvester combine design. Opportunity for advancement for right man. Salary open. O-349-841

AGRICULTURAL ENGINEER for design engineering on harvester combines in the combine division of an established broad line manufacturer. Layout, design and testing. Age open. Harvester combine design experience. Opportunity for advancement for well qualified man. Salary open. O-349-842

PUBLIC HEALTH ENGINEER or Sanitary Engineer or other related academic background and experience, at an eastern state university. Advanced degree desirable. Responsibilities include coordination of existing programs in sanitation, waste handling, inspection procedures, etc., and organization and planning of future programs. Also, some instruction in proper sanitation practices to employees and students. Other related duties. Salary open. O-356-843

AGRICULTURAL ENGINEER (professor or associate professor) for teaching and research in power and machinery or electric power and processing, in an eastern state university. MSAE or equivalent, with experience in a responsible position in a college agricultural engineering department or in engineering industry. Must have initiative, be willing to take responsibility, be able to direct graduate students and work with other staff members. Good opportunity for advancement. Man selected will be expected to show leadership in developing strong programs of teaching and research in his field. Ample supporting funds available. Salary open. O-362-844

NEW POSITIONS WANTED

AGRICULTURAL ENGINEER for design, development, or research in power and machinery with manufacturer, preferably in Midwest. Married. Age 35. Vision corrected by glasses. BSME, 1949, University of Wisconsin. Minnesota farm background. Pre-graduation experience in layout and field test work with farm equipment manufacturer. Post graduation work as project engineer with one manufacturer 2 years, another 6 years. Available on 60 days notice. Salary $8,800. W-347-61

AGRICULTURAL ENGINEER for design, development, research or writing in power and machinery with manufacturer or experiment station, anywhere in USA. Married. Age 28. No disability. BSAE, 1958, Texas Technological College. Farm background. Experience 8 months as installer for Western Electric Company. Military service 18 months in USAF, with advancement to Staff Sergeant. Available on reasonable notice. Salary open. W-345-62

AGRICULTURAL ENGINEER for design, development, or sales in power and machinery, farm structures, or soil and water with manufacturer or processor, anywhere in USA, or South America. Single. Age 30. No disability. BSAE, 1957, University of Missouri. One summer student engineer experience as owner and operator of dairy farm. One year as project engineer on rural buildings, irrigation and drainage. Required military service completed. Available on reasonable notice. Salary open. W-346-63

AGRICULTURAL ENGINEER for development or research in power and machinery with college, federal agency or manufacturer, anywhere in USA. Some travel acceptable. Married. Age 31. No disability. BSME, 1950; MSA, 1951, Cornell University. Army service 15 months. Graduate research assistant to New York Farm Electrification Council 1½ years. One year travel in South and East Africa. With farm equipment manufacturer 2¾ years in engineering and field test of haying machines. With industrial materials handling systems manufacturer 2¾ years in sales and engineering of installations. Available February 1959. Salary open. W-358-64

AGRICULTURAL ENGINEER for sales or service work in power and machinery field with manufacturer, in St. Louis or anywhere in USA. Married. No disability. Trained in department of agriculture, College of Aeronautical and Automobile Engineering, London, England. Experience one year as instructor in training courses with Harry Ferguson, Inc. on diesel tractors and farm implements. Technical supervision in the manufacture of tractors and implements, with Chantier Naval deLa Ciotot, France. Since April 1958, manager in the manufacture of implements, and contractors for farms and tennis clubs, Guillobez and Co., Seine et Marne, France. Available January 1. Salary open. W-363-65

(Continued on page 783)

MEMBERSHIP APPLICANTS

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Baldwin, Geoffrey G.—Agr. machinery advisor, David Brown Industries. (Mail) 25 Barlow Rd., Keighley, Yorkshire, England.

Bitner, Allen—Product complaint investigator, International Harvester Co. Canton works. (Mail) P.O. Box 142, Hanna City, Ill.

Bowling, Robert A.—Division rural engr., Georgia Power Co., Valdosta, Ga.

Bristol, Benton K.—Subject matter specialist, dept. of agr. education, Pennsylvania State Univ., University Park, Pa.

Castator, Donald M.—Farm equip. zone mgr., International Harvester Co. (Mail) 2954 Downing Ave., Jacksonville 5, Fla.

Cherry, Robert E.—Head, agr.-industrial dev. dept., Kengas, Inc., 608 Frederica St., Owensboro, Ky.

Cloud, Burt M.—Asst mgr., Alabama Rural Electric Association of Cooperatives. (Mail) P.O. Box 2568, Montgomery 5, Ala.

Curtis, Robert L.—Soil conservation engr., District Public Works Office, Fourth Naval District, USN. (Mail) 536 Beverly Dr., Catalina Hills, Magnolia, N. J.

Davis, Edwin N.—Asst agr. engr., Colorado State Univ. Exp. Sta., Colorado State Univ., Fort Collins, Colo.

Deoss, Dister L.—On duty with U.S. Army. (Mail) A-Btry., 1st Tng. Bn., USATC, AD, Ft. Bliss, Texas

Drablos, Carroll J. W.—Graduate student, agr. eng. dept., North Dakota Agricultural College. (Mail) 1110 13th Ave. No., Fargo, N. Dak.

Ewan, John G.—Rural service engr., Central Illinois Light Co., 319 5th St., Lacon, Ill.

Fang, Ken Shou—Project engr., Fairbanks Morse & Co. (Mail) 1650 N. San Antonio Ave., Pomona, Calif.

Faust, Ellwood L. — Product engr., International Harvester Co. (Mail) 3141 11th Ave. A, Moline, Ill.

Fenn, Joshua J.—Jr. prof. agr. engr., Agricultural College and Research Institute, Vellayani, Trivandrum, Kerala, India. (Mail) 1215 White Ave., Knoxville, Tenn.

Fly, Clarence M. — Hydrologist, flood prevention planning office, (SCS) USDA. (Mail) 2017 Georgia, Chickasha, Okla.

Ford, John W.—Mgr., Alabama Rural Electric Assn., 3642 S. Perry St., Montgomery 5, Ala.

Fountain, William T. — Soil conservationist (SCS) USDA. (Mail) P.O. Box 487, Wilburton, Okla.

Goodman, Charles K. — Agr. engr. (SCS) USDA. (Mail) 9317 Caroline Ave., Silver Spring, Md.

Guidarelli, Elio J.—Res. engr., Cargill Inc. (Mail) 5409 Irving Ave. S., Minneapolis 19, Minn.

Hagerman, Henry H.—Factory rep., Homasote Co. (Mail) 3459 Dalraida Pkwy., Montgomery 9, Ala.

Hallenberg, John D.—Asst. to mgr., power use dept., Westinghouse Electric Corp., 700 Braddock Ave., East Pittsburgh, Pa.

Herzog, Alphonse W. — Maintenance engr., Green Giant Co., R.R. 1, Montgomery, Minn.

Huener, E. J.—Des. engr., Oliver Corp., 423 E. Michigan Ave., Battle Creek, Mich.

Martin, Chadwick F.—Electrification adviser, Covington Electric Cooperative, Inc., Andalusia, Ala.

Mattson Gordon L.—Partner, Mattson Building Co., Cokato, Minn.

Melanson, Richard E.—Maritime mgr., Farmers Supply & Equipment Ltd. (Mail) 18 Orchard Dr., Moncton, N. B., Canada

Morgan, Hiram A.—Farm service adviser, Kentucky Utilities Co., Elizabethtown, Ky.

Morton, James G. F.—Assoc. prof. agr. electrical and eng., Ontario Agricultural College. (Mail) 75 Martin Ave., Guelph, Ontario, Canada

Olcott, Roger—Owner, Walter Olcott Co., 403 W. Center St., Manchester, Conn.

Oothoudt, Erle H.—Sales rep., Mattson Building Co. (Mail) P.O. Box 148, Cokato, Minn.

Patil, Rudragouda F.—Prof. of agr. engr., College of Agriculture, Dharwar, Mysore State, India. (Mail) Edge Hill Apts., 1900 W. Clinch Ave., Knoxville, Tenn.

Perry Thomas C.—Elecn. advisor, Southern Pine Electric Cooperative, Brewton, Ala.

Peters, Loren W. — Des. engr., J. I. Case Co. (Mail) 1230 Lincoln Rd., Bettendorf, Ia.

Reed, Karl W. — Sales engr., Timken Roller Bearing Co. (Mail) 3522 21st Ave., Rock Island, Ill.

Ridder, Herbert L.—Agr. engr. (SCS) USDA. (Mail) P.O. Box 176, Romney, W. Va.

Seigler, Wilber E.—Asst. agr. engr., Clemson Agricultural College. (Mail) Drawer 247, Blackville, S. C.

Smith, Broadus M., Jr.—Agr. engr., agr. dev. dept., South Carolina Electric and Gas Co., P.O. Box 168, Denmark, S. C.

Smith, Francis R.—Field rep., Portland Cement Association. (Mail) 10 Greenleaf Rd., Natick, Mass.

Stables, David C. Jr.—Dir. of agr. dev., Virginia Electric and Power Co., 7th & Franklin Sts., Richmond, Va.

Stout, W. H.—Owner, Irrigation Accessories Co., P.O. Box 1885, Portland, Ore.

Thompson, Homer S.—Chief, ground management, USAF Hdq. (Mail) 2717 Dawson Ave., Silver Spring, Md.

Thompson, James A.—Inspector, Union Carbide Chemicals Co. (Mail) 609 West Virginia Ave., Dunbar, W. Va.

Thompson, Robert D.—Power use advisor, Pea River Electric Cooperative. (Mail) 524 Oak Ave., Ozark, Ala.

Tomek, Zdenek—Import mgr., Agrostroj, n.p., Roudnice n/L. (Mail) 50 Dusniky, p. Doksany, Czechoslovakia

Trull, Olin C.—Agr. engr., R. H. Bouligny, Inc. (Mail) 820 Charlotte Ave., Monroe, N. C.

Tull, Lawrence E.—Head, grounds and ground structures section, maintenance engr. branch. (Mail) Code M-222, Bureau of Yards and Docks, Navy Dept., Washington 25, D. C.

Vann, James A. Jr. — Elecn. advisor, Dixie Electric Cooperative, Lock Drawer 30, Union Springs, Ala.

Warren, Benny H.—Sales prom. supervisor, International Harvester Co. (Mail) 1944 Margate Ave., Charlotte, N. C.

Wolf, Robert F. — Partner, farmer and rancher, Wolf Bros. & Reich, Albion, Nebr.

Wolfe, Walter W.—Chief engr. and dir., Van Dusen & Co., Inc. (Mail) P.O. Box 375, R.R. 1, Mound, Minn.

TRANSFER OF MEMBERSHIPS

Coombs, Phillip D. — Agr. engr., (SCS) USDA, P.O. Box 72, Moro, Ore. (Affiliate to Associate Member)

Furlong, Donn B.—Chief project engr., Bolens Products Div., Food Machinery and Chemical Corp. (Mail) 337 Woodside, Thiensville, Wis. (Associate Member to Member)

Helms, James O., Jr.—Farm superintendent, agr. eng. dept., Alabama Polytechnic Institute, Auburn, Ala. (Associate Member to Member)

Hinkle, Charles N.—Assoc. prof., agr. eng., South Dakota State College, Brookings, S. Dak. (Associate Member to Member)

Moe, Allen J.—Mfrs'. eng., Perfect Circle Corporation, Hagerstown, Ind. (Associate Member to Member)

Witherspoon, David F. — Asst. prof., eng. science dept., Ontario Agricultural College, Guelph, Canada (Associate Member to Member)

Zoerb, Gerald C.—Assoc. prof., agr. eng., South Dakota State College, College Station, S. Dak. (Associate Member to Member)

. . . Personnel Service

(Continued from page 778)

AGRICULTURAL ENGINEER for design, development, or research in power and machinery with manufacturer in Midwest or East. Single. Age 30. No disability. BSAE, 1949, Purdue University. Experience as test engineer, Nebraska Tractor Test Laboratory 4 months; junior experimental engineer with tractor manufacturer 1½ years; design engineer on tillage tools and forage harvesting machines, 2 years; project engineer, implement research and development over 3 years. Available on 30 to 60 days notice. Salary open. W-364-66

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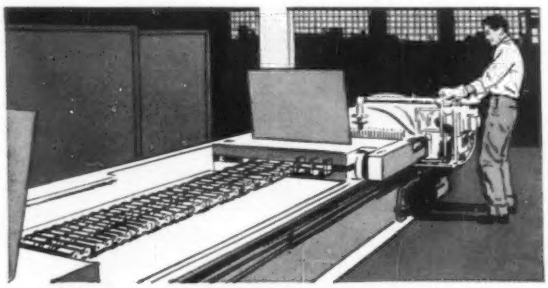

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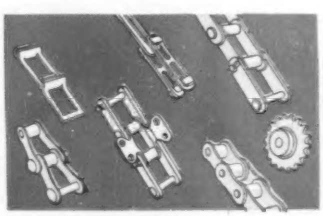

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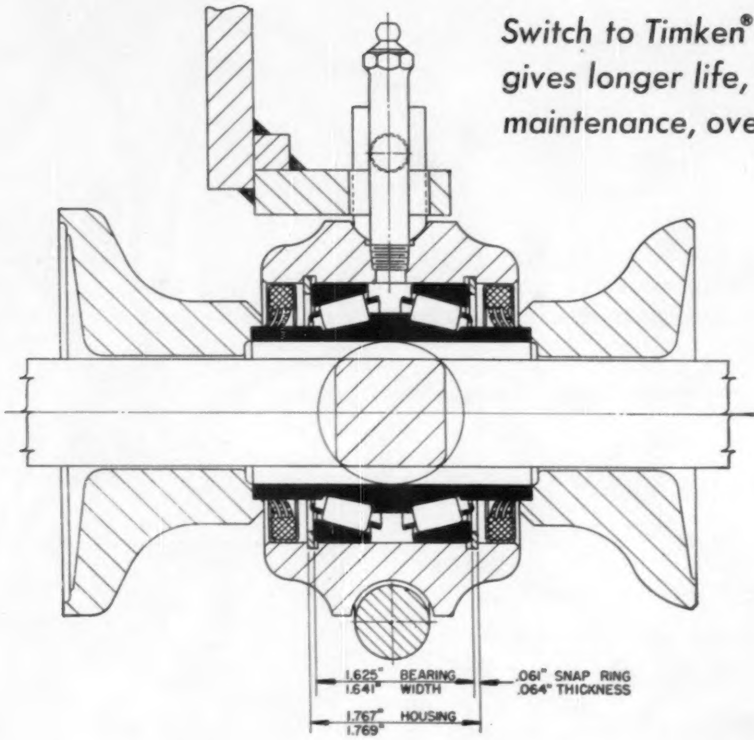
Kewanee gets simpler, more economical design in disk hanger for harrow

Switch to Timken® bearings gives longer life, less maintenance, overall economy



BY switching from plain bearings to Timken® tapered roller bearings, Kewanee Engineers got greater rigidity, reliability and customer acceptance in their new disk harrow. By using a *snap ring pre-adjusted* bearing mounting, they achieved simplicity and economy in machining and assembly.

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